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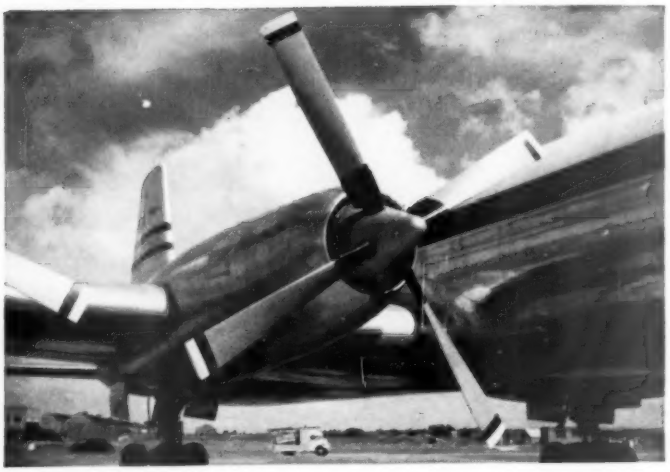

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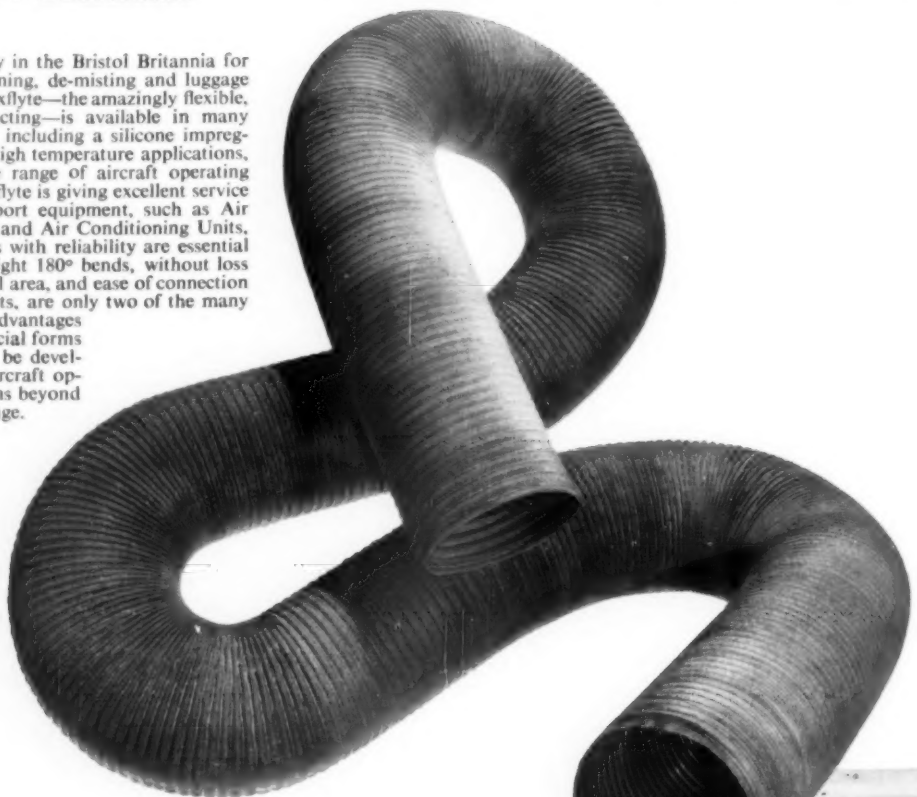

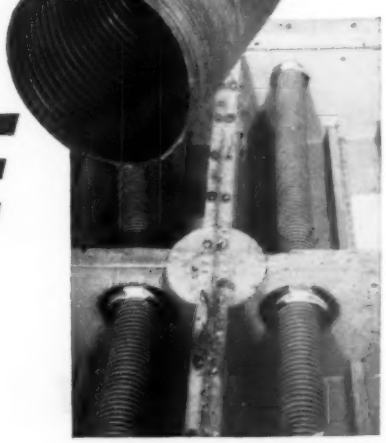

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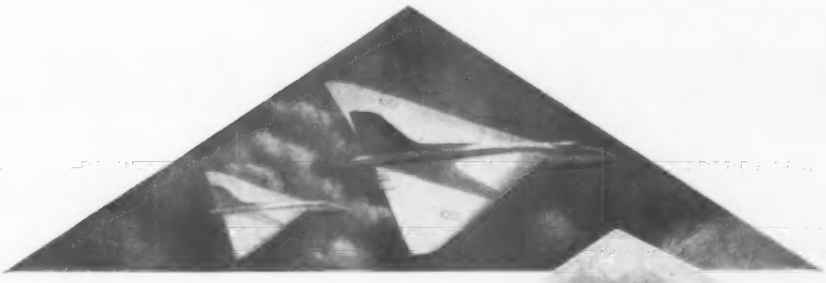

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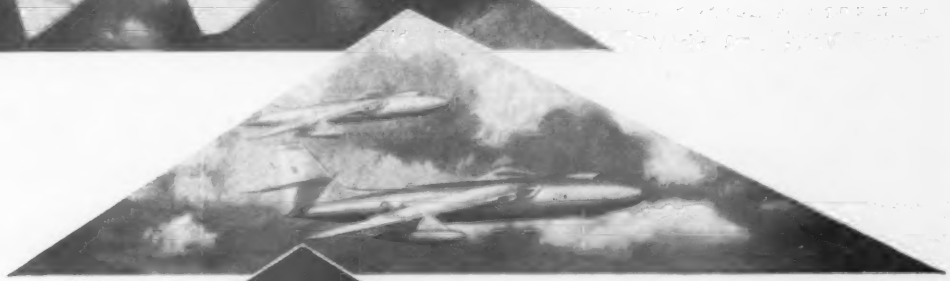

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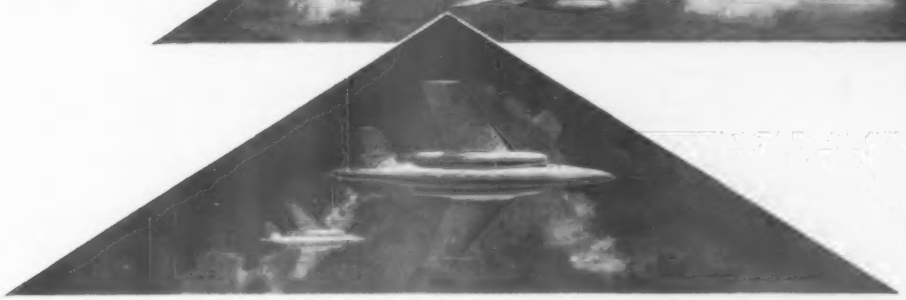

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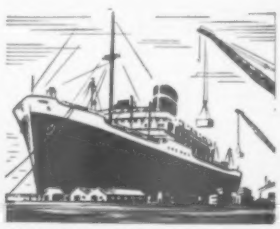

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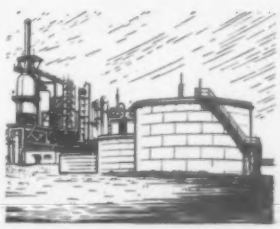

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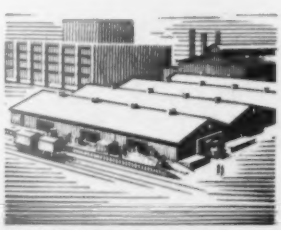

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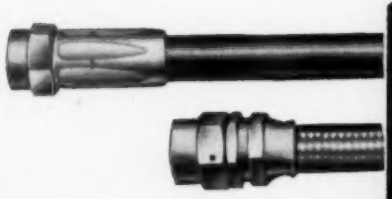

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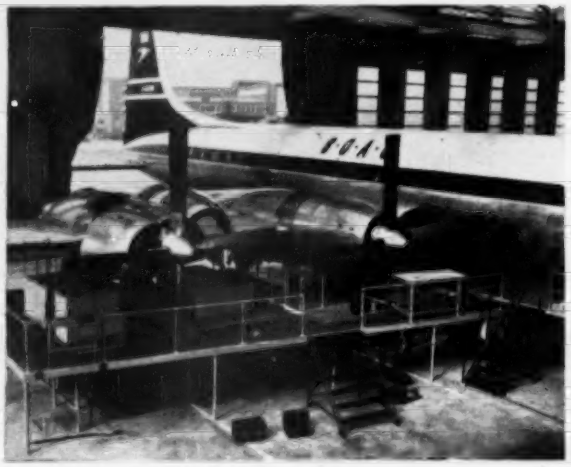

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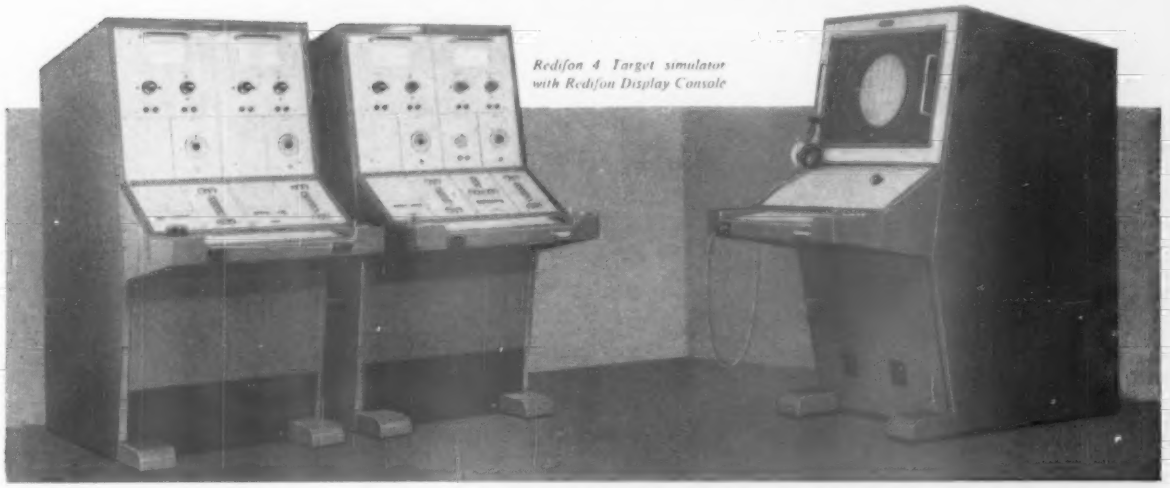

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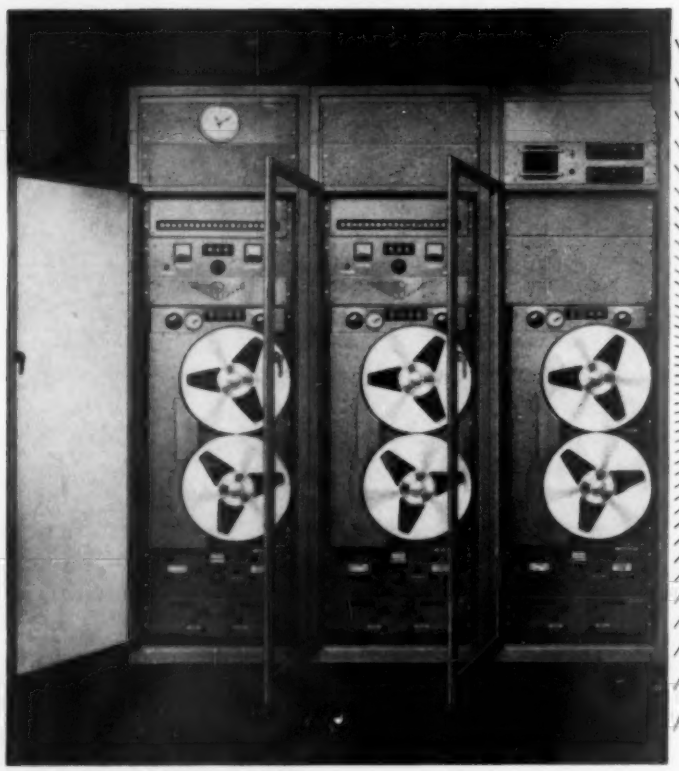

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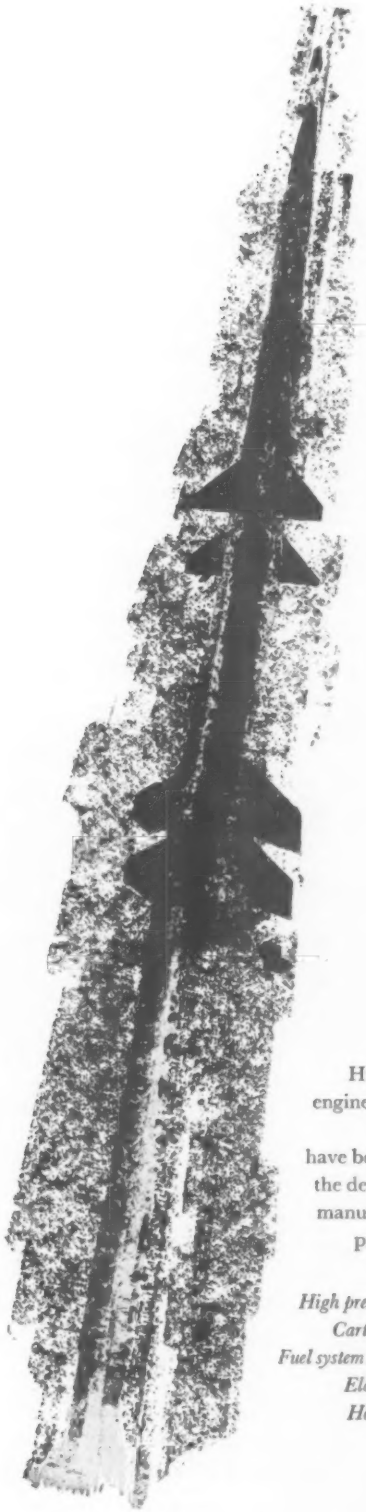

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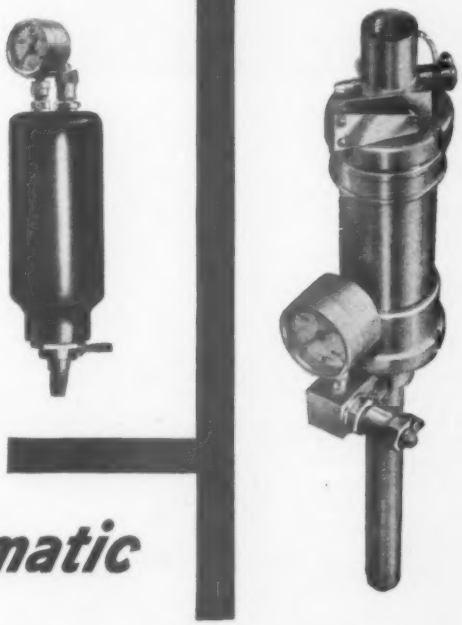

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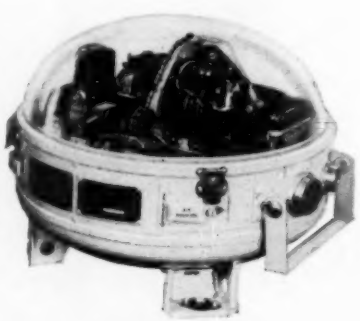

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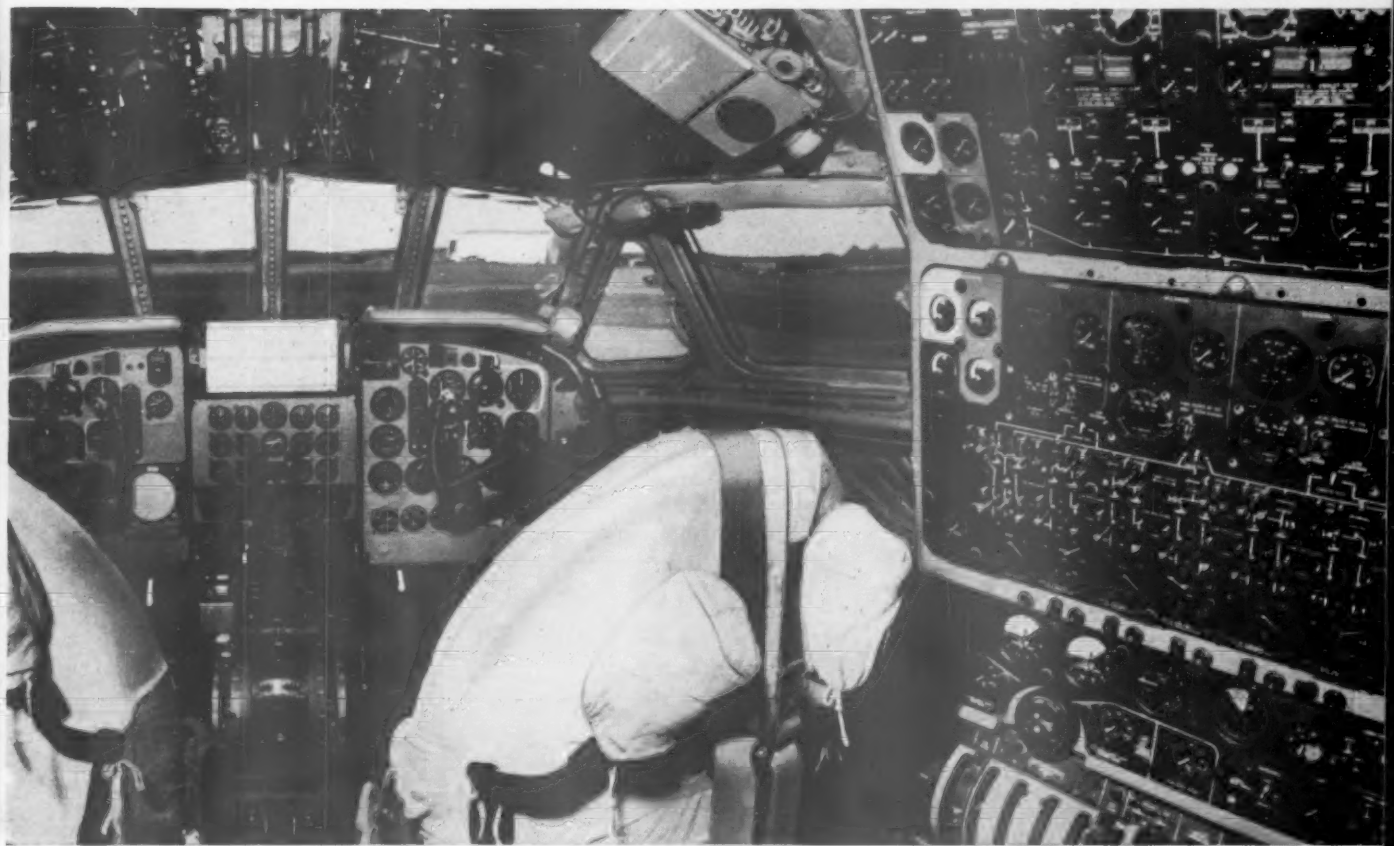

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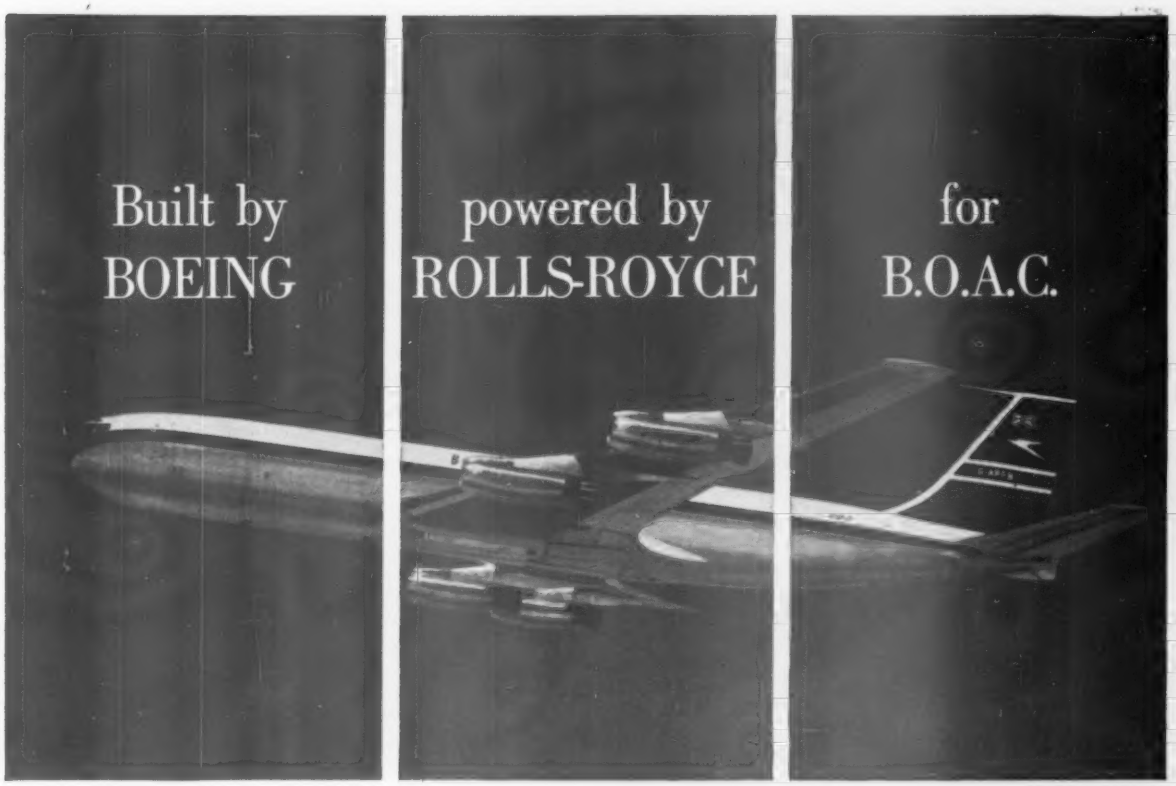

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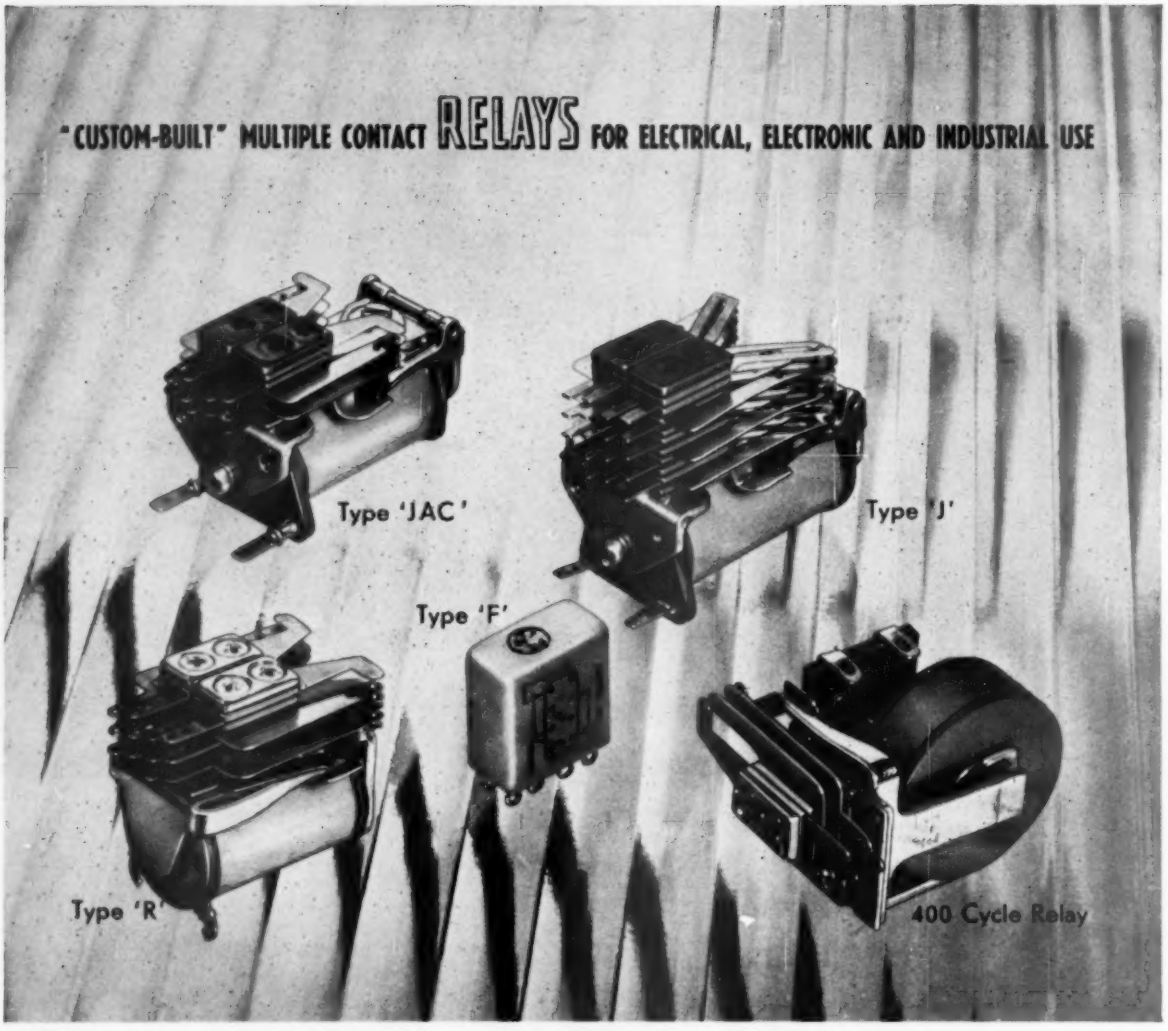

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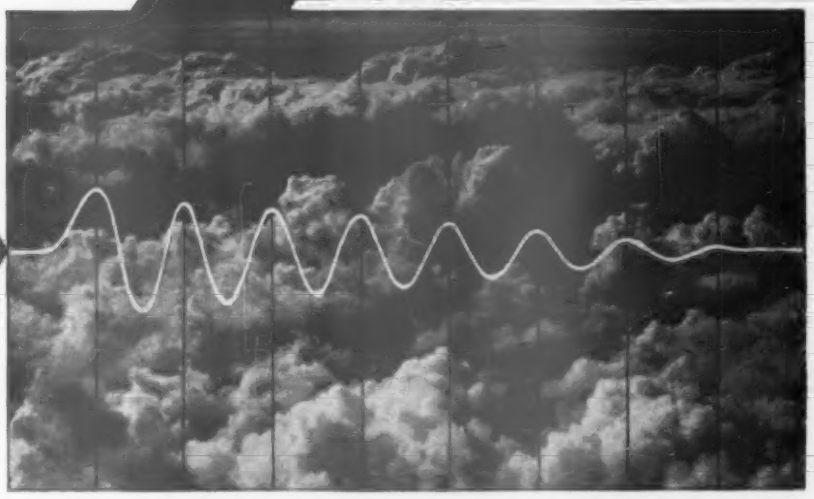

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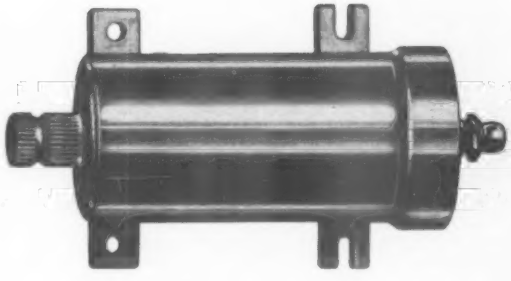

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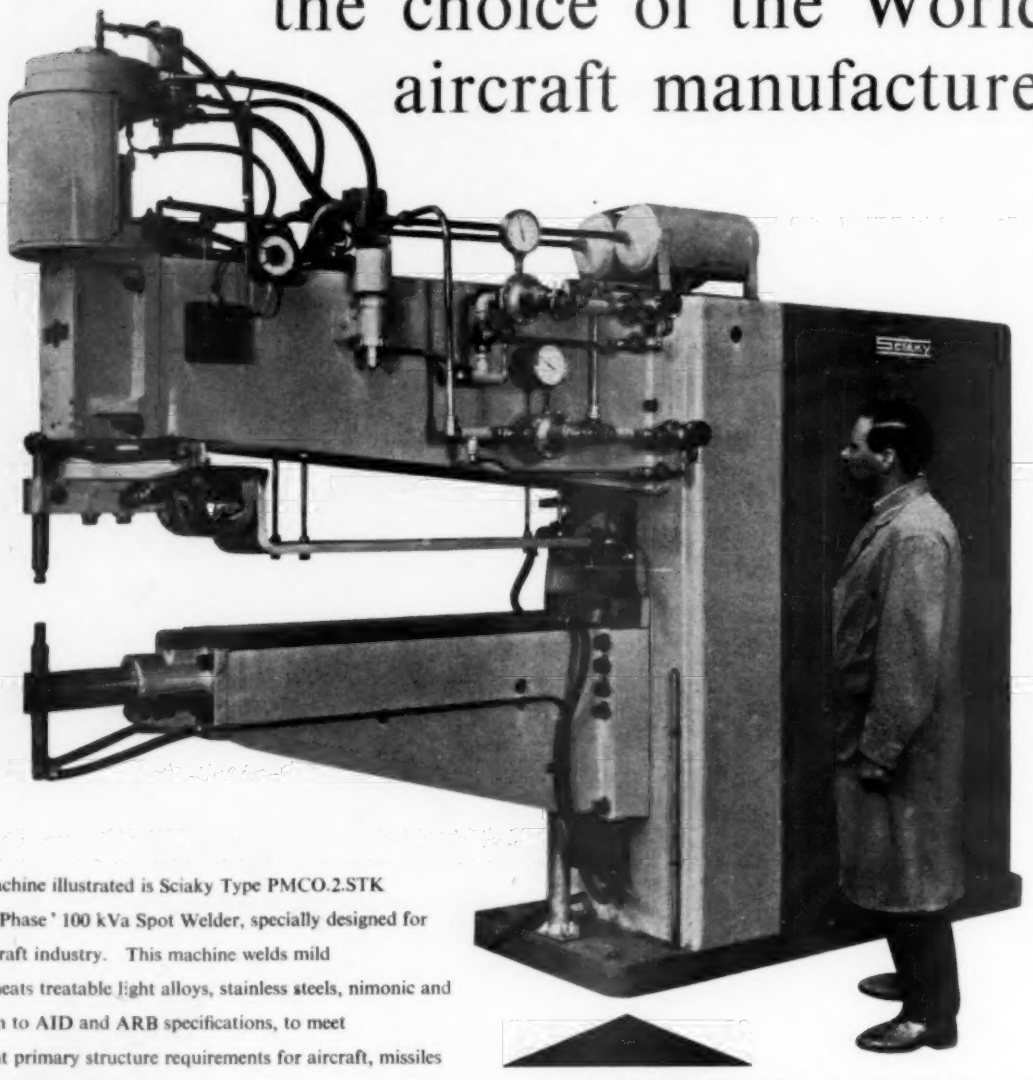

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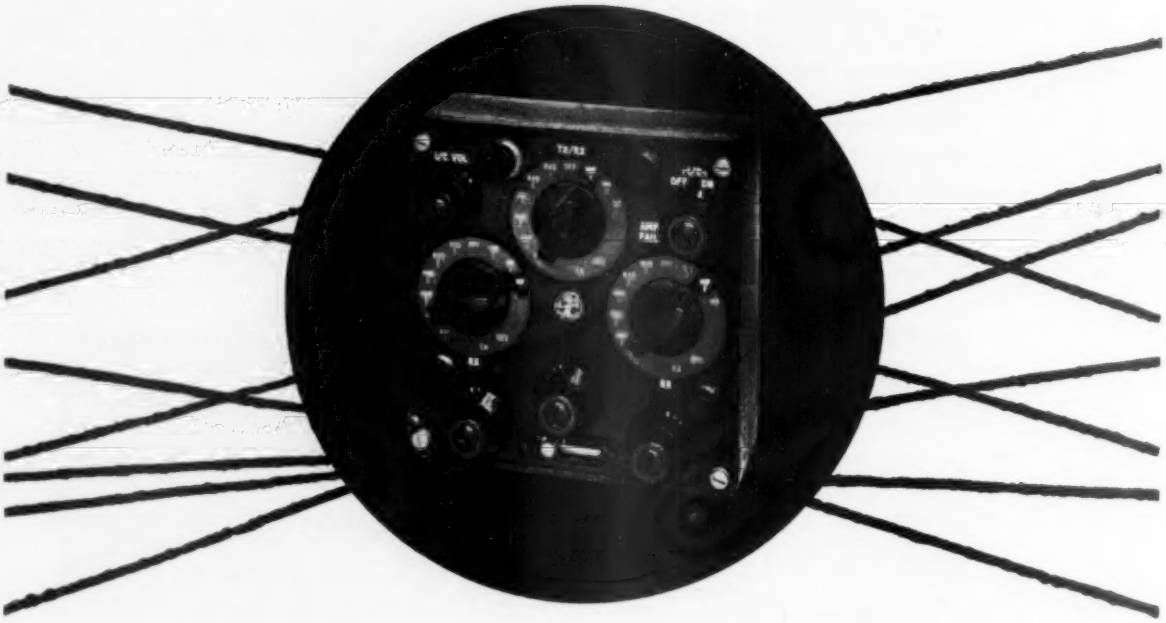

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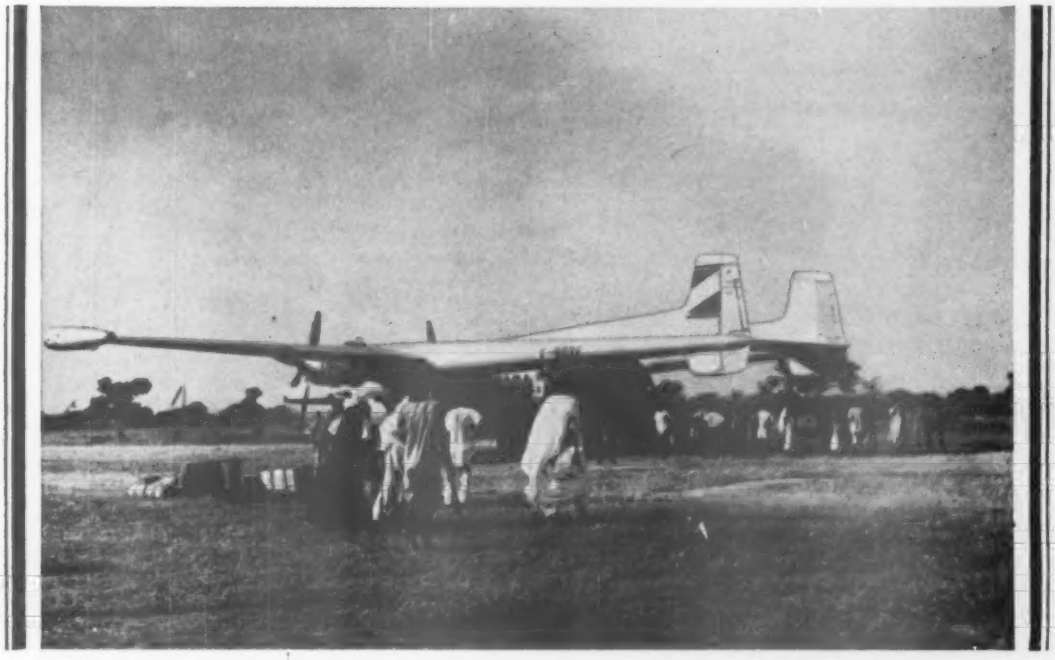

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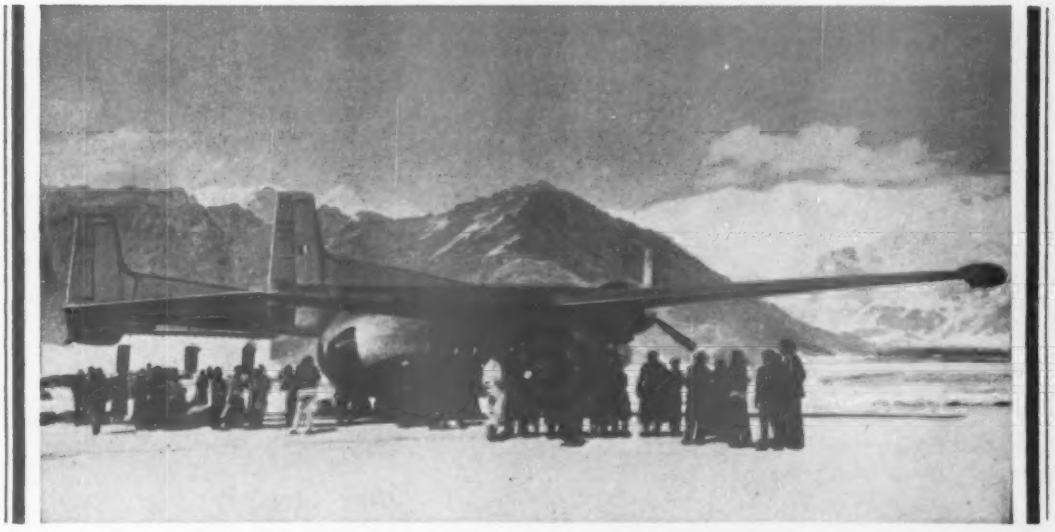

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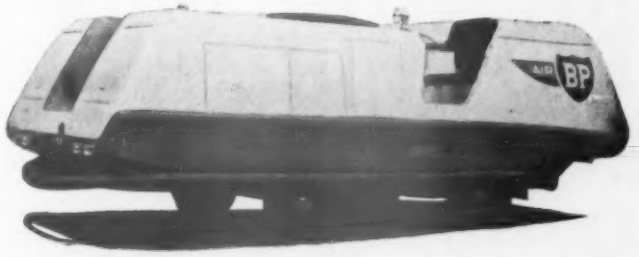

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THE AEROPLANE and ASTRONAUTICS

VOLUME 99 NUMBER 2551 SEPTEMBER 9, 1960

The Show In Being

Size of last week's issue of THE AEROPLANE AND ASTRONAUTICS was visible manifestation of the resources and most extensive capabilities of the regrouped British Aircraft Industry. The contents of this issue will provide our readers everywhere with visible proof of the performance of selected examples of these products in the Farnborough air. It contains also plenty of evidence of the multifarious methods of displaying them in the more-numerous-than-ever stands and display parks which the indefatigable teams of the S.B.A.C. have organized on the southward side of the Royal Aircraft Establishment's historic flying field. Incidentally, apart from the petrified (or should it be plastified) vestiges of Cody's tree, traces of history are hard to find now that the R.A.E. has lost its balloon shed. And amid the turbulent roarings and thunderings and whinings of today's turbines no place has yet been found for even one of the surviving historic aircraft with which this country is richly provided.

Emphasis, understandably, is all on the world-wide appeal of the Show which still preserves its place as the premier occasion of its kind. To it have come 8,000 guests from 115 countries. Among them are a team of Congressmen from the U.S. and a team from the Russian aircraft industrial group.

The practical aspect of such interest is emphasized by the high rate at which aircraft exports continue to run. Figures up to the end of July show that an annual rate of £150 million is being maintained. The important part played in such earnings by aero-engines is confirmed by the fact that sales of these British products in July reached the third highest monthly total ever achieved. The figure for the first seven months of the year exceeds every annual aero-engine export total since the War except those for 1958 and 1959.

As one of the most stimulating performers to be seen at Farnborough is the Short SC.1 "flat riser" it is not hard to visualize the day when British vertical-lift turbines are contributing their share to such export figures. And if the new Hawker P.1127 is not on show its expected capabilities with the Bristol Siddeley BS 53 engine are confidently expected to be such that another very substantial contribution in this highly specialized field is to be expected.

Another specialist field in which the British industry makes a particularly impressive contribution is that of electronics with special reference to navigational aids, aircraft and radar simulators and air traffic control equipment. As with guided missiles the working of this equipment cannot be demonstrated in the same spectacular way as can that of engines and aircraft, but visitors from overseas are taking special interest in these exhibits.

A sign of changing times is to be seen in the exhibition of the French-built and designed Nord CT 41 supersonic drone which is to be serviced and maintained by Armstrong Whitworth in the same way as the Australian Malkara is to be handled by the Fairey Company. This working together with friends across the Channel is likely to increase and in consequence we may expect in the next year or two further internationalizing of the Farnborough Show.

Editor - - - - THURSTAN JAMES
Deputy Editor - - - F. T. MEACOCK

Founder Editor (1911-1939) *C. G. Grey*

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Matters of Moment

Keeping Up the Export Income

ONCE AGAIN, on the eve of its annual Flying Display and Exhibition, the Society of British Aircraft Constructors is able to announce that the level of the industry's aeronautical exports is still showing no signs of falling. Indeed, the official figure of £87,356,369 for the first seven months of 1960—the latest data to become available—works out at an annual rate of earning of £150 million through the sale abroad of the aircraft industry's products. Of this total, the aero-engine industry was responsible for no less than £44.5 million, which is equivalent to a record annual rate of some £77 million, and exceeds every annual aero-engine export total since the War, except 1958 and 1959.

The overall July contribution was £10,940,014, of which £6.5 million came from aero-engines and was the third highest monthly engine total ever achieved. So far this year the exports of aircraft and parts, at £38,700,861, is less than the value of aero-engine exports.

The detailed breakdown of the seven-month total is: aircraft, £23,582,882; aircraft parts, £15,117,929; new aero-engines, £19,518,003; "other than new" aero-engines, £12,291,927; aero-engine parts, £12,702,746; electrical appliances, £2,041,688; tyres, £545,614; instruments, £1,555,530.

Leading buyers of aircraft have been India (£5,453,245); Argentina (£3,880,222); Switzerland (£3,599,580) and the United States (£3,442,698). The purchasers of engines have been the United States (£9,901,303 worth); France (£6,283,555); Canada (£5,452,609) and India (£3,315,895).

For July, the total was made up as follows: Aircraft £1,843,035; aircraft parts, £2,014,574; new aero-engines, £2,954,229; "other-than-new" engines, £1,643,681; aero-engine parts, £1,853,882; electrical appliances, £279,885; tyres, £72,928; and aeronautical instruments, £241,800.

Photograph's copyright "The Aeroplane and Astronautics"

Sir George Dowty, F.R.Ae.S., M.I.Mech.E., F.I.A.S., Hon. F.C.A.I., President of the Society of British Aircraft Constructors, beside his executive Dove.

Space Instrumentation

DETAILS of the first Anglo-American satellite, expected to be launched late next year, were given by Dr. A. P. Willmore, of University College, at the "Rocket and Satellite Instrumentation Symposium" which was jointly organized in London by the British Interplanetary Society and the Society of Instrument Technology on Sept. 1.

Although the design had not yet been "frozen," mainly because information on the American-built telemetering and other equipment is still "rather vague," the speaker said the satellite would probably take the form of a 20-in.-diameter sphere weighing between 100 and 150 lb. The telemeter would have an output of a fraction of a watt and possibly there would be a solar cell power supply. It was hoped that a tape recorder would also be installed for the purpose of storing measurements in orbit.

It was proposed to launch the satellite at an angle of about 50° to the equator so that at times it would pass over Southern England, the perigee and apogee heights being about 200 and 600 miles respectively.

Although primarily designed to study the ionosphere, the satellite will also contain a cosmic ray experiment devised at Imperial College, London. Electron density in the ionosphere will be measured by a technique developed at the University of Birmingham by Prof. J. Sayers in which the capacitance of a sphere immersed in the ionosphere is measured in a radio-frequency bridge.

The remaining experiments are due to University College, London. Two of these are based on the Langmuir probe technique originally used in the study of gas discharges. In this, various parameters of the ionosphere are obtained by a detailed interpretation of the voltage-current characteristic of an electrode placed in the ionosphere. In the first experiment, this electrode will consist of a disc which is part of, but is electrically insulated from, the satellite skin. In order to analyse the composition of the positively charged particles in the ionosphere, a spherical probe will be mounted on an arm 12 in. long.

Ionization chambers and proportional X-ray counters will be used to monitor the emission of ultra-violet light and soft X-rays from the Sun, in order to correlate ionospheric storms with disturbances occurring in the atmosphere of the Sun.

Other papers given at the Symposium were: "An outline of the British space research programme," by Mr. M. O. Robins, University College, London; "Ultra-violet measurements from satellites," by Dr. J. Ring, University of Manchester; "Ground equipment for radio observations on artificial satellites," by Dr. B. G. Pressey, Radio Research Station, Slough; "The measurement of the performance of liquid propellent rocket engines," by Mr. A. W. T. Mottram, Bristol Siddeley Engines, Ltd.; and "An equipment for processing time multiplexed data," by D. J. McLauchlan and T. T. Walters, Bristol Aircraft, Ltd. Arrangements are being made to publish these in the Journal of the British Interplanetary Society.

Britannics to Have Autoland

A TRIPLEX automatic landing system is to be installed in the 12 Short Britannic C.1 strategic freighters on order for R.A.F. Transport Command. Based on the techniques established by the R.A.E. Blind Landing Experimental Unit at Bedford, it will be a fully automatic system as opposed to the partial or auto-flare facility providing pitch control only which is to be applied in the first instance to the de Havilland Tridents for B.E.A. as part of a two-stage programme leading towards fully automatic landing.

The Britannic autopilot system will have triplication of the essential automatics and is a military version of the civil duplex S.E.P.5 equipment under development by Smiths Aviation Division for the Trident. This latter transport is expected in airline service in 1962 and the R.A.F. is hoping to receive the first of its Britannics in 1964.

Flying in the company's Dakota for over one year, the S.E.P.5 is the latest of Smiths range of autopilots and, as already stated, incorporates the multiplex philosophy for providing an acceptable reliability minimum for automatic landing. Other units in the complete Britannic airborne installation will include Murphy azimuth guidance equipment and a Standard Telephones radio altimeter, possibly the STR-40. A new instrument designed specifically for automatic landing requirements, this altimeter has a single height range of 500 ft.

Discussing Blue Streak's Future

ANGLO-AUSTRALIAN talks on the subject of Blue Streak and the possible use of Woomera as a launching base for space research opened in Canberra on Aug. 29. They are intended to lay the groundwork for discussions which Mr. Peter Thorneycroft, the Minister of Aviation, is to have with the Australian Government when he arrives in Australia on Sept. 13.

The British delegation is led by Sir Steuart Mitchell, director-general of Weapons and Electronics at the Air Ministry. After the initial meetings in Canberra, the party was due to continue talks in Melbourne and then to visit the Weapons Research Establishment at Woomera.

Although it would be rash to anticipate the results of these discussions, many observers feel that an agreement will be reached with Australia to use the range in a joint programme

of space research. In this case, it would be expected that the necessary funds for continuing with Blue Streak as a satellite launcher would appear in the Ministry of Aviation budget, and that the development of scientific payloads would remain with the Minister for Science, Lord Hailsham. Non-scientific payloads, such as communications and reconnaissance satellites, would also logically come under the Ministry of Aviation and be at least partially subscribed from the defence budget.

Flying Laboratory

A SPECIALLY equipped Il-14 of Polar Aviation left Leningrad on Aug. 17 for the port of Tiksi on the northern Arctic coast of the U.S.S.R. The aircraft has been prepared for the Aero-meteorological Expedition, headed by A. I. Voskredensky, under the ægis of the Arctic and Antarctic Institute. The expedition will last for six weeks and will consist of weather reconnaissance flights to high latitudes.

Flights will be made to obtain observations of synoptic and general aero-meteorological interest. The synoptic observations will be transmitted direct from the aircraft to Arctic forecasting bureaux for the benefit of ships sailing on the northern sea route.—F.J.F.

W. S. Shackleton Changes Hands

SOME 29 years after the founding of the Shackleton and Lee Murray partnership, an agreement was signed on Aug. 25 last whereby all the shares of W. S. Shackleton, Ltd., were purchased by Mr. Raymond Way. Changes have been made to the board of directors as follows:—

Mr. W. S. Shackleton has resigned from the board of directors but has been appointed president of the company and will continue to work with the company for another period of 10 years as president and technical consultant.

Mr. Raymond Way, as the principal shareholder, has taken over as chairman.

Mr. Keith Shackleton will remain as sales director.

Miss M. H. Campbell, Mr. Raymond Way's personal secretary, will join the board, as will Mr. T. J. Cable, who is the senior partner of Messrs. Wm. Charles Crocker, solicitors.

Mr. F. A. Dismore, who has been elected managing director, states that the policy of the company will remain as before, but it is hoped that more rapid expansion of its activities can take place with the greater financial backing that will now be available.

No changes will be made to the staff, and with Mr. W. S. Shackleton to guide the company, untroubled by the monetary problems of day-to-day business, the company is confidently looking ahead to consolidating its position as Europe's leading aircraft brokers.

One who knows Mr. Way well writes:—

One of the most colourful and most volatile figures ever to erupt—that word aptly expresses it—into the motor and motorcycle retail firmament, 52-year-old Raymond Way possesses a flair for publicity which has long been a joy to the Press and to TV and broadcasting interviewers seeking an "angle" on news affecting the motoring masses. It is this faculty which has expanded his famous used-car business in North-West London into the largest in Britain.

Raymond is a popular after-dinner speaker—in a broad sense—and I have known him drive 50 miles from his Hertfordshire farm through extremely bad winter weather simply because he had promised to attend a small motorcycle club function. His bonhomie and occasional clowning conceal a shrewdness seldom equalled and Raymond's assessment of the value of people, cows and cars is unerring; which may have some bearing on the fact that he is reputed to be a millionaire!

"Taffy" Jones—Fighting Man

WHEN a friend heard the news that "Taffy" Jones had died in a Swansea hospital on Aug. 29 last he commented that to die in bed had not seemed a likely fate for this fighter pilot of dash and distinction. Credited with the destruction of 28 enemy aircraft, three balloons and the shooting down of 10 aircraft out of control, he was popularly reputed to have survived 28 crashes in the First World War.

James Ira Jones was born in 1896, educated at Carmarthen Grammar School and went straight into the Welch Regiment when war started in 1914. He transferred to the R.F.C. in 1915 and in the autobiographical "An Air Fighter's Scrapbook" can be found his story of the years in which as one of the first fighter pilots he earned the D.S.O., M.C., and M.M. To these was added the D.F.C. when he was an observer officer in desert fighting in the turbulent early days of the R.A.F.'s first command in Iraq. He retired from the Services in 1936.

"Taffy," who held a permanent commission in the R.A.F., failed to get very far in the Service largely—it is held—by his slightly rebellious outlook towards certain types of peace-time authority. But in his own way he was a splendid officer and a stern disciplinarian, characteristics which many officers, now very senior indeed, must have recognized when as very junior pilot officers on probation they went through his hands on their initial introduction to uniform and commissioned service at the R.A.F. Depot, Uxbridge. It must have seemed very strange to them when a bemedalled ex-fighter ace in a fascinating stammer bawled them out for scruffy shoes or too much hair—but that was "Taffy."

His intense earnestness about Service affairs was only matched by his brilliance as a Welsh Rugby International and R.A.F. team man. When he retired from playing he became one of

FIGHTER DEVELOPMENT.—Next week the Royal Air Force ceremonially commemorates its part in the Battle of Britain and opens a large number of its stations to the public. This line-up of R.A.F. fighters at Coltishall covers development from 1940 to the present day. In this special "parade" are a Hurricane, Spitfire, Meteor, Hunter, Javelin and Lightning.

the most distinguished referees the game has known, and after that he wrote a regular Sunday newspaper feature about it for many years.

The story of Major Mannock, V.C., was put into book form by him in 1934, and under the title of "King of Air Fighters" made the claim on "Taffy's" air observations for its hero to hold the title of greatest air fighter of them all. Much controversy was aroused at the time particularly when most of Europe and many of our own people gave this credit to Richthofen. "Taffy" dismissed the latter as a circus leader and one who gained his victories by cleaning up the stragglers after a circus performance.

"Taffy" returned to his native Wales before World War II, but came back for a while as a Station Commander on one of the operational training bases. From all accounts he was still a fighter and a stickler for discipline even then. It is that way many of us will remember him.—C.A.S.

Lady Bailey

AN outstanding woman pilot of light aeroplanes between the Wars, the Hon. Lady Bailey, D.B.E., died at her home near Cape Town in her 70th year on Aug. 29 last. The only daughter of Lord Rossmore of Monaghan she married the South African millionaire, Sir Abe Bailey, in 1911. She learnt to fly in 1926 and was the second woman to get her "A" Licence when the light aeroplane clubs came into being on the advent of the de Havilland Moth.

She was born in 1890 and was the mother of a growing family when she learnt to fly at the London Aeroplane Club at Stag Lane, getting her licence soon after Mrs. Sophie Elliott Lynn who first introduced me to her. Lady Bailey soon began to make a name for herself in air racing, competing in a meeting at Bournemouth first and in races for the King's Cup and other trophies. In July, 1927, she set up a British height record of 17,283 ft. for light aeroplanes with Mrs. (later Lady) de Havilland as passenger in her Cirrus Moth.

She is best remembered for her magnificent flight in a similar aeroplane to Cape Town by way of Egypt returning by the West Coast route through Nigeria which she was the first to pioneer. She badly damaged the Moth in Kenya so her husband sent her another in which she continued the flight (1928-29).

Before starting on the flight from Stag Lane she told me she was flying to see her husband in Johannesburg and as she knew nothing about mechanics and had no experience of transcontinental flying she'd be lucky if she got there. But she made it all right though her route took her over the treacherous Sudd swamp. She stayed a short while in Johannesburg and then "thought it would be fun to fly right down to Cape Town" which she did.

The return journey by the little-known West Coast route was accomplished without incident save that she flew the last lap from Paris to Stag Lane on three cylinders. On landing she told A. J. Brant her engine had not been making the usual even purring sound so he examined it and found a rocker arm missing! For this flight she was awarded the 1929 Britannia Trophy.

On exchanging her Cirrus Moth for a Gipsy Moth she thought she'd better learn something about engines so went to Alan Eadon's engine classes where she learnt that the Cirrus with open breathers showed 3 lb. oil pressure but the Gipsy showed 35 lb. Not being mechanically minded she was a bit confused, and on her next flight, to the Midlands, she noticed her oil gauge for the first time and saw it was reading 35 lb., correct for her Gipsy. But 35 lb. sounded an awful lot, she told me later, so she landed in a field and telephoned de Havillands for assistance who told her nothing was wrong.

"Truly a case of ignorance being bliss," she told me gleefully, "for I'd been quite happy flying 18,000 miles round Africa not realizing such a thing as oil pressure even existed!"

She was a real pioneer in feminine flying and her example did much to persuade others—men as well as women—that the light aeroplane as a practical vehicle anyone could fly the World over had arrived.

A widow since 1940 she is survived by two sons and two daughters.—G.D.

Aviation News in General

TREBLE-ONE LIGHTNINGS. — At the end of this season's aerobatic displays No. 111 Squadron (Sqn. Ldr. P. Latham) will re-equip with English Electric Lightning F.1s. No. 92 Squadron (Sqn. Ldr. R. H. B. Dixon) is to take over the Treble-One task of providing the Fighter Command aerobatic team.

WESSEX TRIALS.—No. 700 "H" Flight at R.N.A.S. Culdrose is at present undertaking the Service's evaluation trials of the Westland Wessex HAS.1 helicopter. Commanded by Lieut. Cdr. R. Turpin, the unit is expected to have six aircraft by the end of this year and will continue its task, including all-weather flying, until the middle of 1961.

BLACKBURN BUCCANEER.—The Admiralty has now officially named the Blackburn NA39 the Buccaneer. On Aug. 26 we recorded that this was the rumoured name for the Navy's new low-level strike aircraft.

HELICOPTER DOPPLER. — A $300,000 contract from the U.S. Navy Bureau of Weapons has been awarded to Ryan Electronics of San Diego to incorporate "recent advancements" into earlier models of Ryan AN/APN-97 Doppler navigation sets. This equipment comprises a helicopter hovering and ground velocity indicator; it first went into production in April, 1957.

ARB NOTICES.—A series of new issues of Notices to Licensed Aircraft Engineers and to Owners of Civil Aircraft was published on Aug. 15 by the A.R.B. They included No. 2 issue 15, "Renewal of Aircraft Maintenance Engineers' Licences"; No. 9 issue 5, "Aircraft Maintenance Schedules and Certificates of Maintenance"; and No. 45 issue 3, "Privately Owned Aircraft and 3-Year Period Certificates of Airworthiness."

3,000-hr. DARTS. — Trans-Canada Airlines' Rolls-Royce Darts are now being operated for 3,000 hours between overhauls. T.C.A., which introduced Viscounts in 1955, has 235 Dart 506 powerplants for its fleet of 49 Viscounts.

SIXTY SERIES.—B.O.A.C. has specified the new Marconi "Sixty-Series" of airborne communication and navigation equipment for its fleet of 35 Vickers VC 10s.

INSTRUMENT CONGRESS.—The 5th International Instrument and Measurements Exhibition is to be held in Stockholm from Sept. 10 to Sept. 17. A large number of British companies are exhibiting their products; and Temple Press Limited, publishers of THE AEROPLANE AND ASTRONAUTICS and other technical journals covering this particular field will have a stand in the exhibition jointly with George Newnes, Ltd., and Heywood and Co., Ltd.

AIR BOOST.—Possibility of using the B-70 Mach 3 bomber as a recoverable first stage booster for launching Dyna-Soar, Samos and Midas satellites is being investigated by North American Aviation. Orbital vehicles would be fitted with a new intermediate stage booster and would be released from the aircraft at about 70,000 ft.

ANTI-MISSILE TRIALS.—Test facilities are being set up at Kwajalein in the Pacific for Nike Zeus test firings to intercept ICBM warheads launched from Vandenberg A.F.B. in California, which is 4,800 miles away.

TOP STAGE.—Third stage of the Minuteman ICBM will have pivoting nozzles for thrust vectoring and a thrust termination feature for accurate control of range. Hercules Powder Company claim that the solid propellent used has the highest specific impulse of any measured to date with such propellents.

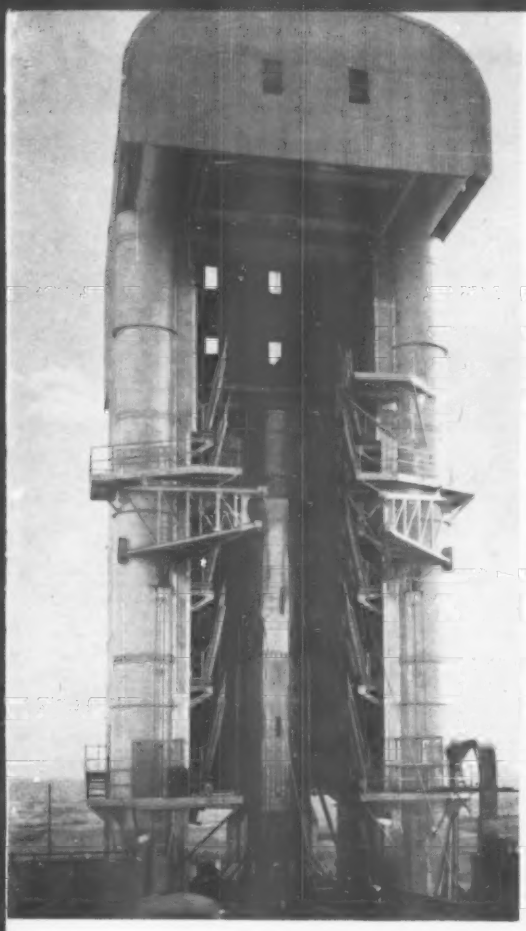
UP-RATED.—A new version of the Thor-Thorad with three jettisonable solid propellent boosters has been proposed by Douglas to improve performance.

COACHMAKERS' COURT.—At the meeting of the Court of the Worshipful Company of Coach Makers and Coach Harness Makers on Sept. 1 the following officers were elected for the ensuing year: Master, Sir Reginald Verdon Smith; Senior Warden, Col. G. A. Morris, O.B.E.; Renter Warden, Mr. P. S. Croall; Junior Warden, Lt.-Col. R. T. Harris.

A.W.A. EXECUTIVE.—Following the recent retirement of Armstrong Whitworth's chairman and managing director, Mr. H. M. Woodhams (THE AEROPLANE AND ASTRONAUTICS, Aug. 19, 1960), Sir Roy Dobson, vice-chairman and managing director of the Hawker Siddeley Group, becomes the company's chairman. Mr. W. S. D. Lockwood, A.W.A. general manager, has become managing director.

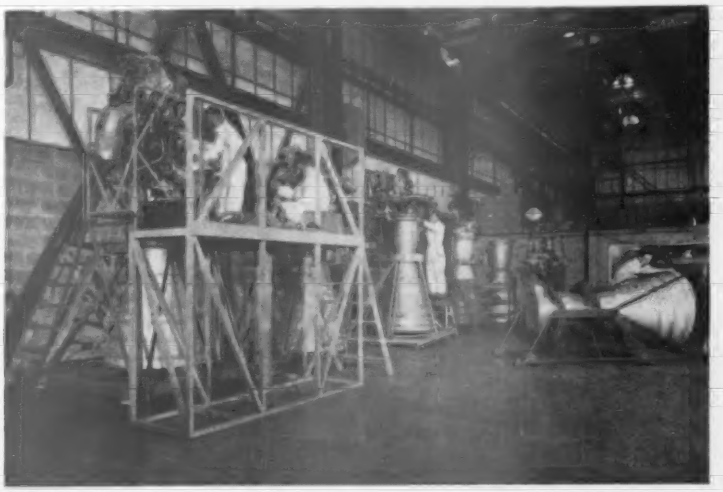
B.E.A. APPOINTMENT. — The Minister of Aviation has reappointed Mr. A. C. Ping as a member of the B.E.A. board for a further two years.

AEROBATIC LOSS.—It is with great regret that we record the death of Leon Biancotto, three times World Aerobatic Champion and triple winner of the Lockheed Trophy. He was killed last week during practice for the International Aerobatic Championship at Bratislava.



First Spadeadam Pictures

Three-page story on pp. 383-385



TEST STAND.—At present the system tests of Blue Streak are being made in this engine test stand (above) as the facilities in the missile test area have not been completed.

MISSILES AND ENGINES.—Complete Blue Streak LRBMs were to have been checked out and statically fired at this site (top). The servicing tower stands above a launch pad of the type built at Woomera for Blue Streak. Above, Rolls-Royce RZ.2 liquid-oxygen/kerosene rocket engines for Blue Streak are assembled before they are test fired.

CONTROL ROOM.—Engine firings at any of the three completed test stands are controlled and observed from this room (above). Periscopes and closed-circuit television are used for visual checks on engine running.

ENGINE RUN.—Approximately 135,000 lb. of thrust is produced by this Rolls-Royce rocket engine seen on test (right). The dark jet in front of the main chamber is the turbopump exhaust.

Air Transport

Moscow's New Airport

By Michael Brander*

ON Jne. 1, 1960, Aeroflot opened a new international airport for Moscow, replacing Vnukovo, former international gateway of the U.S.S.R. The new terminal is Sheremetievo-South and it shares a single runway with Sheremetievo-North, a domestic airport.

The field is 28 km. N.N.W. of Moscow, near the Leningrad highway. The road journey time varies from 40 to 60 min., depending upon traffic density. This represents a slight increase over the road journey to Vnukovo from Moscow (45 min.).

Apart from technical aspects, the opening of Sheremetievo-South was most unusual in one respect. In mid-May, airline managers came to understand that a move was imminent, but no details were available and no one was able to view the yet-uncompleted international terminal. Foreign carriers continued to share, with Aeroflot's international operations, the congested international/domestic field at Vnukovo, and only Sheremetievo-North was known, to some foreign representatives, in connection with local flights to points westwards of Moscow (such as Leningrad, Riga, Minsk and Kaliningrad). Beyond the south side of the runway stood a new terminal, surrounded by trees. It was out of bounds to visitors.

After looking at airports professionally for 21 years in different countries, and sitting on planning committees to some extent, it was with a feeling of considerable speculation that I joined my colleagues, in a coach kindly provided by Aeroflot, and, with leading officials from their international department, set off from Moscow on May 24, to view the new airport. We then received confirmation that all our flights would be transferred to Sheremetievo from Jne. 1—i.e. in eight days' time!

One hour later we were welcomed at the new terminal by the Station Manager and we started on a guided tour of the premises. These were almost ready for use and were already furnished. Even the flower beds were planted.

It was quickly evident that there were many advantages in this transfer. First, there was no domestic traffic to cause congestion and, secondly, provisions for passengers, flying and ground staff were better than those at Vnukovo. Thirdly, the technical facilities, runways, lighting and approaches were superior.

On May 31, we dispatched our last Comet 4B flight from Vnukovo, and then transferred the B.E.A. airport unit by road to the new base. Aeroflot provided trucks and staff and with much co-operation from them we completed the move in one day. On Jne. 1, our new unit was in working order; the office given to us was in use, teleprinters and telephones were available, and our stores and equipment were installed in the new location. On the following day Aeroflot gave an official opening ceremony, and Col.-Gen. Loginov, Director General of Aeroflot, declared the inauguration of the new Moscow gateway to be completed. Toasts were given and medallions commemorating this occasion were presented to all guests.

Passengers arriving at Sheremetievo-South are quick to notice the unusually pleasant and attractive aspect of this terminal. The apron is surrounded by trees, mainly silver birch, and there is also an artificial lake, with fountains and bench seats, under the trees, for those who feel the need for some moments of rest from the cares of airport life. As one passenger has remarked, it is the most unusual setting for an airport and just what one would hope to see on landing in Russia.

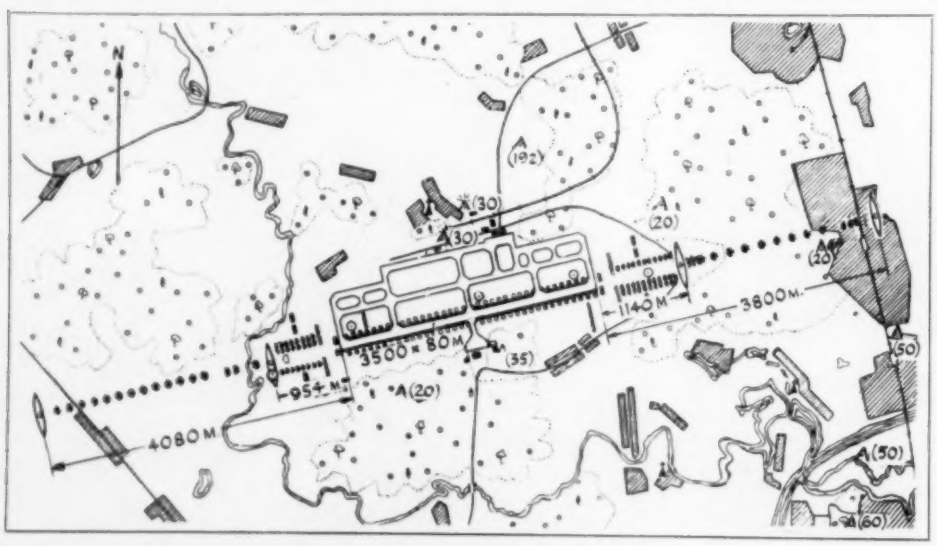
The runway lies (symbolically enough!) in an East and West direction, is 3,500 metres in length, 80 metres wide and is of concrete construction (see plan). A short concrete lead-in, from the centre of the runway, provides access to the triangular apron in front of the terminal building.

Approach lighting is excellent, having a length of 4,080 metres at the western end and of 3,800 metres at the eastern end. Lighting brilliancy is adjustable.

The reference-point position, at the runway centre, is 55°58'N, 37°25'E, with an elevation of 190 metres A.S.L. The precise runway bearing is 68°-248° magnetic (variation +8°). This runway can accept all types of aircraft throughout the year. There are few significant approach obstructions.

Landing systems include ILS (the type usable by western aircraft will be available by autumn 1960); non-directional beacon system (two NDBs); RSP radar-controlled talk-down

* Manager, B.E.A., U.S.S.R.



This plan of Sheremetievo shows that lighting and approach aids are available in each direction for the single 11,500-ft. runway. The new international terminal is on the south side and its building, seen from the apron, forms the heading picture on this page.

The main concourse, or waiting room, at Sheremetievo-South—the new international terminal for Moscow.

system, which can be given in English; and the use of VDF stations. An identification beacon, coded "AD," in red, is located in the approach area to Runway 25. Aircraft approach from the west via Klimentievo NDB, to Ivanovskoe NDB, between 2,400 and 3,600 metres, and proceed as instructed by approach control (located in the control tower at Sheremetievo-North). Deviations from the approved approach pattern are, of course strictly prohibited.

At the new terminal all international flights of Aeroflot to the west and east operate together with those of all foreign carriers (currently Air France, Air India, Austrian Airlines, B.E.A., Finnair, K.L.M., Sabena and S.A.S.) from countries outside the Soviet group, and C.S.A., Deutsche Lufthansa (East), LOT, MALÉV (Hungary), TABSO (Bulgaria) and TAROM (Rumania) from East European countries. At present there are about 20 flights daily. The present terminal is brand new and contains passenger servicing areas, waiting rooms, buffets, restaurant, shops; such services as post office, international telephone office, medical rooms, bank, offices of Intourist and the Administration Bureau for the Diplomatic Corps; and sections for police and Customs. All these provisions are well laid out and equipped. In this respect they are much better than some formerly available at Vnukovo, which were temporary, or makeshift, in character.

Departing passengers go through a pass-control filter to the check-in area, which employs the "Orly" system of common check-in and Customs clearance. The "Orly" system, as we know it, also happens to be the Soviet system and is favoured by western operators. Following these clearances, passengers are free to enter the large, modern waiting room, which contains a souvenir shop and a well-equipped buffet, or to go out on to a terrace overlooking the concrete apron. Incoming passengers pass through a reversed system of controls at the opposite side of the terminal waiting room. Passengers on flights which have already touched down at points within the U.S.S.R. do not require passport control (i.e., flights from Peking, New Delhi, etc.).

Adjacent to the main terminal is another block, which houses technical flight-planning offices, such as Met., A.I.S. and flight-clearance, together with offices allocated to the airlines for their own technical use. Load and trim sheets, manifests and other ships' papers are, however, prepared in the main building in a common documentation office controlled by Aeroflot.

Cargo is at present handled in a wooden building of a temporary nature, situated on the main road behind the large car park. Aircraft catering services can eventually be accommodated in a commodious cellar space in the main terminal, but are at present located at Sheremetievo-North, which involves transportation over seven km. each way.

There are two further buildings under construction near the terminal and these will be used as passenger check-in and control areas. This will relieve later congestion within the terminal itself, which will then be used mainly as a waiting area.

Transfer between Sheremetievo-South (International) and Sheremetievo-North (Domestic) is effected by road, and takes about 15 min. Frequent local bus services provide connections to Moscow city centre and also to Vnukovo, where all domestic flights to eastward destinations within the U.S.S.R. are now located. In addition, there is a Sheremetievo/Vnukovo air link, with a half-hourly frequency, using Li-2s or Il-12s. This shuttle service is also used by Aeroflot for taking staff to work and from one location to the other. There is also an Airport-City service, using 11-passenger Mi-4 helicopters which make 12 round trips per day.

Since the opening of the new airport, B.E.A.'s Comet 4B flights have experienced few teething troubles in the new terminal and we find that the facilities are much better than those formerly available at Vnukovo.

The only real difficulty lies with the distance now involved between the terminal area and the aircraft catering unit on the north side. This has sometimes caused delay. To put this right, however, vigorous steps have been taken and service is now good. In all other respects conditions are easier. Passenger areas are more attractive in design and less congested. The restaurant and buffets are better equipped and service is prompt. Distances between the apron, flight-planning offices and terminal are shorter—a great advantage in the winter months. Apron lighting is first class and aircraft can park near the building. Turbojets can start up on the parking bays and the tedious, time-wasting process of towing jet aircraft away from parking points for starting is unnecessary.

It was an extraordinary experience for most of the western representatives to have first sight of a new airport one week before our transfer—and the more so for us to find a complex of brand-new and fully equipped facilities ready for use. It was an even more unusual experience for us to make the move in a single day, assisted as we were to a generous extent by Aeroflot staff (and also, in our case, by a helpful policeman, who helped to winch up heavy equipment). Our experience of this move has been a thoroughly happy one. Very few difficulties were experienced and we have found the degree of co-operation and interest in our work, which is shown by Aeroflot supervisory and other staff, to be most marked. Turnrounds are closely watched by Aeroflot personnel and immediate concern and analysis follow any hold-up, or the emergence of any unusual problem.

I believe that Aeroflot are proud of this new international airport—which was so rapidly developed from its original design, as a "diplomatic" airport for special flights, for its present use. In our view they have every reason to be pleased with the result achieved. Sheremetievo-South reflects not only a dramatic improvement from the point of view of facilities; it is also one of the most attractively situated national gateways in use. With the very evident interest and goodwill displayed by Aeroflot, Customs, police and other official bodies, it is also a pleasant airport for the foreign representative.

By way of contrast to the picture on the previous page, this is the landside approach to the terminal, the purpose of which is appropriately inscribed both in Russian and English.

Air Transport . . . .

ICAO and the Supersonic Transport

ANYBODY who is prepared to read beyond the five-page summary in ICAO's 118-page study of the supersonic transport* is likely to put this report down with the conviction that no Mach 3 aircraft will be safely *and* profitably used in airline service much before 1975.

The study assumes the possibility of an initial introduction in 1970 and the problems and their solutions are discussed with a calm objectivity amounting almost to a dead-pan acceptance of the likelihood that the airline and manufacturing industries may succeed in meeting this date—but only as a fairly desperate technical and economic gamble.

The impression which the ordinary reader gains from the study is that a very major co-operative international effort will be needed if the supersonic transport is to be in operation—with adequate research and experience behind it—by 1970.

If ICAO's study causes a few people to think a little less emotionally about the problems which have to be solved the Organization's secretariat will not have wasted its 40,000 words and its 20 pages of tables and graphs.

The directly technical problems of design and operation are obviously not insuperable, even assuming no more than a 10-year time-scale, and co-operation will help to smooth out the difficulties associated with air traffic control, fuel reserves and automatic navigation systems.

The study, however, says very little—presumably because there is no knowledge available—about very-high-altitude cruising conditions, except to make the comment that "turbulence may be experienced up to the highest cruising altitude" and that "the aircraft will have to be strong enough to tolerate, when cruising at a speed of Mach 3, any turbulence which may exist. Data on gust magnitude will be required to determine the design requirements." In an earlier section, when referring to passenger comfort, the study also says: "Accelerations may be important in phases of flight other than take-off and climb; for example, it seems possible that high-velocity air streams or sudden corrections in course may cause vertical or sideways accelerations of considerable magnitude."

Here, then, is a vitally important field for international work and co-operation. The mass entry of the subsonic turbojets was preceded by a period of some 10-12 years during which military aeroplanes with comparable performances were regularly operating in a similar environment. We are now considering the introduction of transports 10 years from now in an environment which has been explored only by a few U-2s and at speeds which have so far been reached only during research flights.

The need to avoid serious sonic-boom discomforts in populated areas will require cruising altitudes of at least 60,000 ft. for Mach 3 transports and of 45,000 ft. even for Mach 1.3 transports. Since the supersonic penetration of rain or hail "cannot be tolerated" and cumulo-nimbus cloud-tops are found up to 45,000 ft. in the temperate latitudes and up to 60,000 ft. in the tropics, it is obvious that cruising levels of about 60,000 ft. upwards must be assumed.

Nobody knows anything very much about conditions at these levels. At greater altitudes (70,000-100,000 ft.) there are the so-called nacreous (mother-of-pearl) clouds which are believed to consist of minute supercooled water droplets, or particles of vitreous ice: nothing is known about the possible erosion effects of such particles. The minimum normal turning radius of a Mach 3 airliner is likely to be of the order of 140 miles, so visual avoiding action does not seem to be practical. There can be no question of subjecting the early fare-paying passengers to a series of proving flights on an "it'll be all right you'll find" basis. The experience must be obtained in advance.

The ICAO study estimates that by 1967, if all long-haul traffic were to be flown in 100-seat supersonic transports, there might be a requirement for 125 Mach 3 or 188 Mach 2 airliners, almost half of which would be in use over the North Atlantic. The respective figures for 1973 would be 202 and 303.

More practical are the estimates for the number of supersonic airliners needed each year to cover annual expansion and losses if no other new aircraft are delivered. These figures, for Mach 3 transports (Mach 2 numbers in brackets), are: 42 (63) in 1967; 49 (73) in 1970; and 51 (76) in 1973. The supersonic aircraft would take over the long-haul services, while the subsonic fleet would be demoted for other duties.

Finally, it should be stressed that ICAO's study has not been completed in an ivory tower. It has been prepared on a basis of replies received to a detailed questionnaire which was circulated to all contracting states and to IATA—which was not, at least at that time, able to offer opinions or comments. This Association plans to hold a supersonic symposium in the spring of 1961.

* "The Technical, Economic and Social Consequences of the Introduction into Commercial Service of Supersonic Aircraft." A preliminary study by the Secretariat of the International Civil Aviation Organization. International Aviation Building, 1080 University St., Montreal 3, P.Q., Canada. Price: $1.25 (Canadian), 8s. 8d., or equivalent currency at date of publication.

The Tight Little Island

ONE point about B.E.A.'s recent suggestion that passengers should, where possible, use the airline coach (see our issue of Aug. 26, p. 258) might usefully be expanded. The flight concerned will always wait for the coach—whose passengers have already completed formalities at the West London Air Terminal—but cannot wait for individual passengers or small groups of passengers who have still to be processed at the airport. The coach passenger, once through the W.L.A.T., can therefore relax in the knowledge that his aircraft seat is assured.

The whole problem has arisen partly because the big traffic increases could not have been envisaged when the L.A.P. plans were finalized and partly because an island site is, by its nature, incapable of expansion. It remains to be seen whether the use of the long-haul building in the central area will seriously increase the traffic congestion.

The effect of this extra traffic may not be so very great; long-haul passengers are numerically few by comparison with short-haul passengers and the congestion periods are likely to be different. Nevertheless, long-haul aircraft are, on the average, of much bigger capacity and the coaches and cars carrying 150 or so passengers will be arriving within a half-hour period and will be using the same entry tunnel.

If the plan for centralizing all L.A.P.'s passenger facilities remains unchanged then it is obvious that more use will have to be made of Gatwick by the short- and medium-haul intra-European carriers. Those passengers who are merely going to and from a Continental or domestic centre find that Gatwick, with its rail link, is a convenient point of departure and entry—but the trouble comes when inter-line traffic is being handled. The Gatwick-L.A.P. coach journey is not a particularly quick one and an air service between the two airports would be both expensive and troublesome in an overloaded traffic pattern.

The answer to the problem of ensuring a more effective use of Gatwick appears to rest with the airlines, which must co-operate and co-ordinate their services accordingly. Nobody can expect B.E.A. to "go it alone" in the use of Gatwick while other operators are using L.A.P. and selling the idea of easier inter-line connections to those passengers for whom London is merely a staging post.

With Gatwick's positive advantages for so many operations, there should be no great difficulty in coming to a series of agreements. Sooner or later a large proportion of the services will need to be transferred from L.A.P. whether the carriers like it or not. It will be very much better to agree to transfer in good time and in good order.

FIRST SWING-TAIL.—On Aug. 25 the first of the Canadair CL-44 swing-tail freighters was rolled out at Cartierville, Montreal.

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G

UNBRAKO AD

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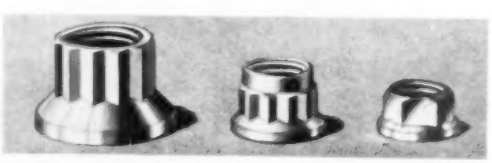

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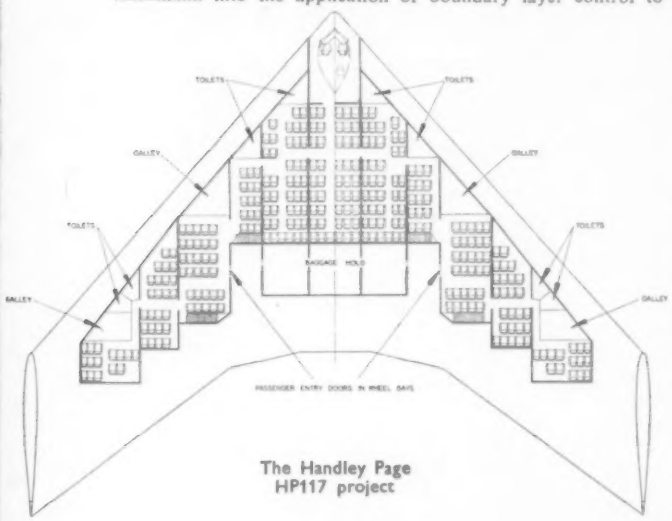
Air Transport . . . .

Shapes of the Future?

AMONG the exhibits in the tent at Farnborough this week are two which suggest the possibly unorthodox shapes of future transport aircraft. Both are, at present, in the nature of design studies, but are in fields where continued research may well pay large dividends.

The Handley Page HP117, a lay-out plan of which is published below, is the latest in a series of studies by Dr. G. Lachmann into the application of boundary layer control to transport aeroplanes. The concept, in this case, is for an all-wing subsonic transatlantic aircraft seating 300 passengers.



The Handley Page HP117 project

The Boulton Paul P.146 project

The wing surface would be completely laminarized, using suction slots. Cost estimates—which have not been published in detail by Handley Page—indicate that the total direct trip cost between London and New York might be of the order £1,650, or £5 10s. per passenger.

The second project illustrated here is the Boulton Paul P.146, one of a series of design studies on VTOL configurations made under M.o.A. contract. This is a 46-seat short-haul transport for stages up to 500 miles. Four banks of direct-lift engines are employed, at the tips of the mainplane and the noseplane, and variation of the thrust of these units provides control at zero forward speed. Two conventional thrust engines are located on the rear fuselage.

Development of lift units by both Rolls-Royce and Bristol Siddeley with power to weight ratios as high as 16 : 1 makes schemes such as this worth more study. A note on lift engines and the Griffith airliner employing them appears on page 359.

Commercial Aviation Affairs

EXECUTIVE HELP.—Mr. Maurice Curtis and Mr. Bryan Greensted, formerly managing director and operations director, respectively, of Hunting-Clan Air Transport, have formed a new company called Curtis Greensted Associates. It will offer operation, management or advice in any air transport activity and is intended in particular to serve the development of business and executive flying.

JUNE TRAFFIC. — U.K. airlines' traffic on scheduled and inclusive tour services in June amounted to 50 million short ton miles, an increase of 22% over June, 1959. Capacity operated was up by 28% and the overall load factor fell from 63% to 61%. In the first half of 1960, total traffic was 214 million short ton-miles, an increase of 24.4% on the first half of 1959.

QUEBECAIR 540s. — Two Eland-powered Canadair 540s have been bought by Quebecair. The Napier-Canadair demonstration 540 has been leased to the airline while the aircraft are being made ready.

T.A.A. TAKES OVER.—Last week Trans-Australia Airlines took over the Papua/New Guinea domestic services and equipment after nearly 20 years of operation by Qantas.

JAN SMUTS EXTENSION.—The main runway at Johannesburg's international airport is being extended from 10,500 ft. to 14,000 ft. so that South African Airways' 707s can, if necessary, fly non-stop to Europe. The Great Circle distance between Johannesburg and Rome is 4,168 naut. miles. The work is being done by an organization formed of South African Railways and the four provinces of the Union.

CAMBRIAN PROGRESS. — Results for 1960, to Aug. 6, show that Cambrian Airways' traffic has, by comparison with the same period of 1959, increased by 52% on international routes, with the Paris service contributing an increase of 39%. If expansion continues, Cambrian hopes to introduce Viscounts on some services in 1963.

BOEING DELIVERIES.—All three Boeing 707s for South African Airways have now been delivered in Johannesburg. They will be named "Johannesburg," "Cape Town" and "Durban" before going into service on Oct. 1.

MILLION HOURS.—The commercial Pratt & Whitney JT3C has recently completed a million hours in airline service. This total was accumulated by the engines in 109 Boeing 707, 720 and Douglas DC-8 airliners serving with eight airlines. The JT3C is the first pure jet to reach this total in commercial flying, but several turboprops have exceeded a million hours.

N.Z. FRIENDSHIPS.—The first of the N.Z. National Airways Corporation's eight Fokker F.27 Friendships is due to reach Wellington on Nov. 21 and will enter service on the Christchurch-Wellington-Auckland route on Dec. 22.

TO COMMAND.—Mr. G. J. Warcup, as recorded last week, will succeed Mr. G. J. H. Jeffs as commandant at London Airport on Oct. 1.

DAKAR ACCIDENT. — An Air France L-1049 flying on the service from Paris to Abidjan crashed into the sea off Dakar on Aug. 29. Three abortive approaches to the airport had previously been made in high winds and heavy rain. The crew of eight and 55 passengers lost their lives.

DONINGTON AIRPORT? — An application has been made by the Derby Corporation for planning permission to re-open the R.A.F. aerodrome at Castle Donington, Leicestershire. A proposal that this aerodrome should be developed to serve Derby, Nottingham and Leicester was first made four years ago.

H

Discussing Aviation Medicine

IN the week preceding the S.B.A.C. Show at Farnborough a remarkable amount of space was devoted by the daily papers to the proceedings in London of the Fifth European Congress of Aviation Medicine which was opened by the Minister of Aviation, Mr. Peter Thorneycroft, at the beginning of the week in the Royal Festival Hall. The proceedings of the Congress itself took place in the Royal College of Surgeons of England in Lincoln's Inn Fields. And there the 250 delegates from 25 countries were kept continuously occupied for the rest of the week. Not only was there a continuous and well-planned lecture programme, but an exhibition was devoted to such aspects of flight as comfort, hygiene and safety survival, also air/sea rescue including aids to location and resuscitation of survivors and pharmaceutical problems of aviation, rations and fire-fighting.

Guests were greeted at a cocktail party on Monday night given by B.E.A. and B.O.A.C. On Tuesday they were entertained at the Festival Hall for a performance of Giselle by the Festival Ballet. On Wednesday there was a reception and dance at Guildhall at which the Lord Mayor, Sir Edmund Stockdale, was host and, in conclusion, a final dinner-dance and cabaret at Talk of the Town on Friday. To wind up there was a special visit to the S.B.A.C. Show.

The arrangements, always under strain in an international congress, seemed to work very well indeed and for this the guests have to be grateful to all those companies who co-operated together as hosts for the various functions, and above all to the organizing committee. Its members were: Dr. A. Buchanan Barbour, Director, Medical Services, B.E.A. (chairman); Surgeon Captain S. W. Baskerville, representing Medical Director-General, Royal Navy; Dr. K. G. Bergin, Director of Personnel and Medical Services, B.O.A.C.; Air Cdre. J. D. Leahy, Senior Medical Officer, Ministry of Aviation; Gp. Capt. J. Howard Lewis, representing Director-General, Medical Services, R.A.F.; Lt.-Col. M. M. Lewis, representing Director-General, Medical Services, Army; Mr. R. L. Weir, Financial Controller, B.E.A.; Sir Harold E. Whittingham, Flying Personnel Research Committee, and Doctor Kempton P. Hare.

One thing was put sharply into focus by most of the papers presented—that machines will tend to get out of the control of men if maximum attention is not paid to human engineering and psychiatry. At present-day flying speeds and altitudes, and with the reliance which has to be placed on fast-" thinking " automatic devices of many kinds, the human pilot is already working at near-maximum capacity in emergency conditions.

Tomorrow's supersonic aircraft will be much more demanding and the time has come for aviation medicine specialists to be brought in during the very early stages of aircraft design—for the benefit of future passengers as well as of flight crews.

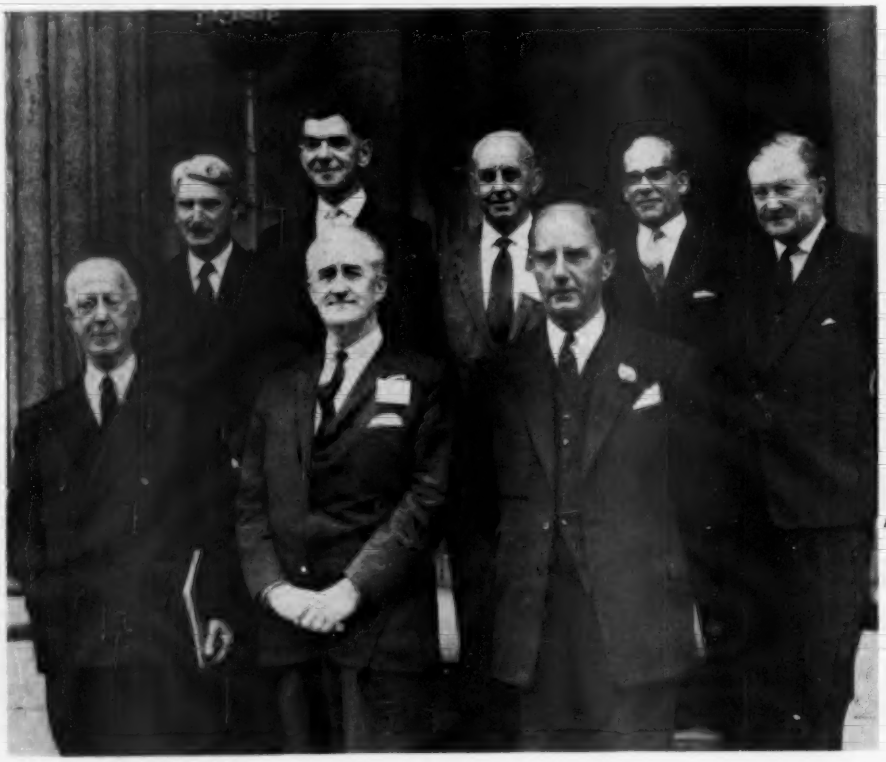
Accidents and Human Error

During the four working days of the Congress some 60-odd papers were read. Many of these were of specialist interest, but a large proportion dealt with problems and difficulties which could be appreciated by everyone who is connected with aviation. More immediately important, perhaps, than the papers devoted to human reactions in supersonic and space flight were those concerned with the selection of pilots and the study of their day-to-day reactions and behaviour.

It may be a fact that accidents due to pilot error can usually be attributed with equal justice to deficiencies in design which caused the pilots to be overloaded to a point of failure—but it might be equally true to say that pilots could be picked and trained in such a way that overloading would not be a cause of human failure.

As Gp. Capt. H. P. Ruffell Smith (R.A.F. Central Medical Establishment) said in his paper, there may be human difficulties in arranging for the necessary data to be obtained and applied. Aircrew members and even airline operators tend to be sceptical about the possible benefits and may look on such research as being an unwarrantable personal interference. But there should, and must, be some way of getting the aircrew and managements on the side of the aviation medicine specialists so that all can work together to improve flight-deck conditions and to raise safety levels. Gp. Capt. Ruffell Smith said that there was a foreseeable requirement for the carrying of data recorders in all transport aircraft so that aircrew performances could be measured and comparisons made for various conditions of work-load, fatigue and even pilot age. Other speakers

(Continued on page 347)



ORGANIZING COMMITTEE.—Members of the committee organizing the aviation medicine congress were: Front row (left to right), Sir H. E. Whittingham, Dr. A. Buchanan Barbour, Dr. K. G. Bergin; back row (left to right), Gp. Capt. J. Howard Lewis, Lt.-Col. M. Martin Lewis, Air Cdre. J. D. Leahy, Dr. Kempton P. Hare, Surgeon Capt. S. W. Baskerville. Mr. R. L. Weir, also a member of the committee, is not present in this photograph.

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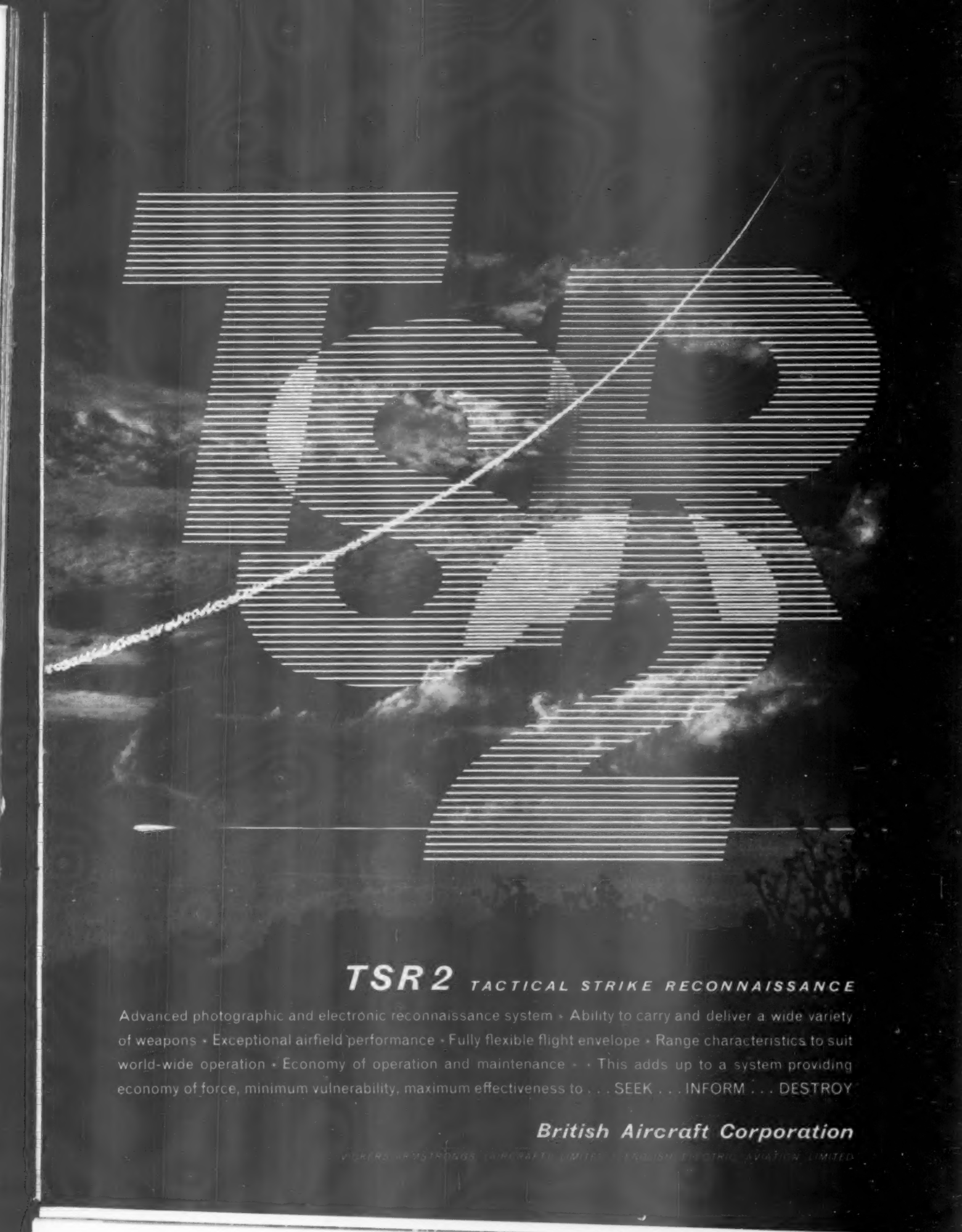
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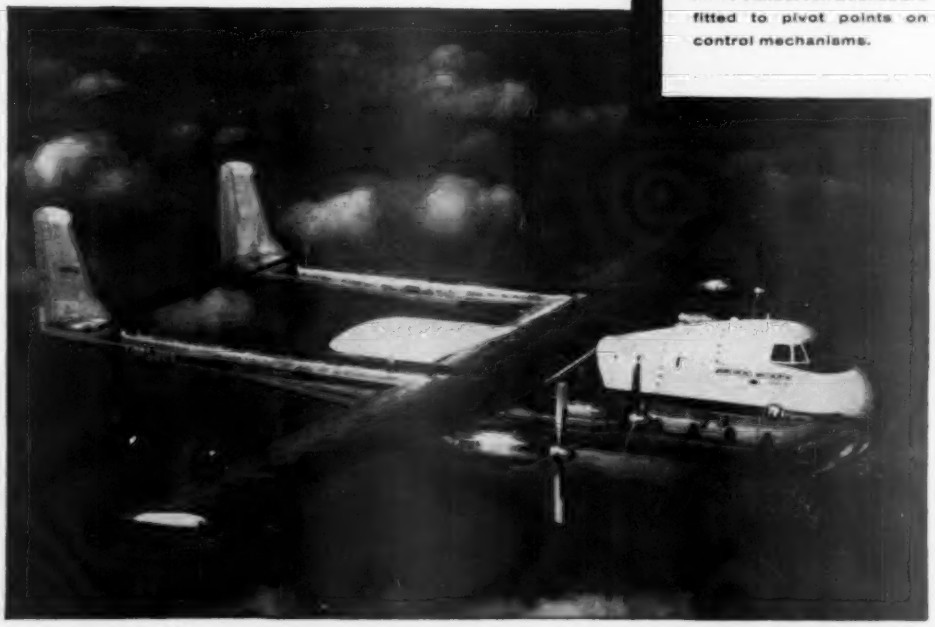
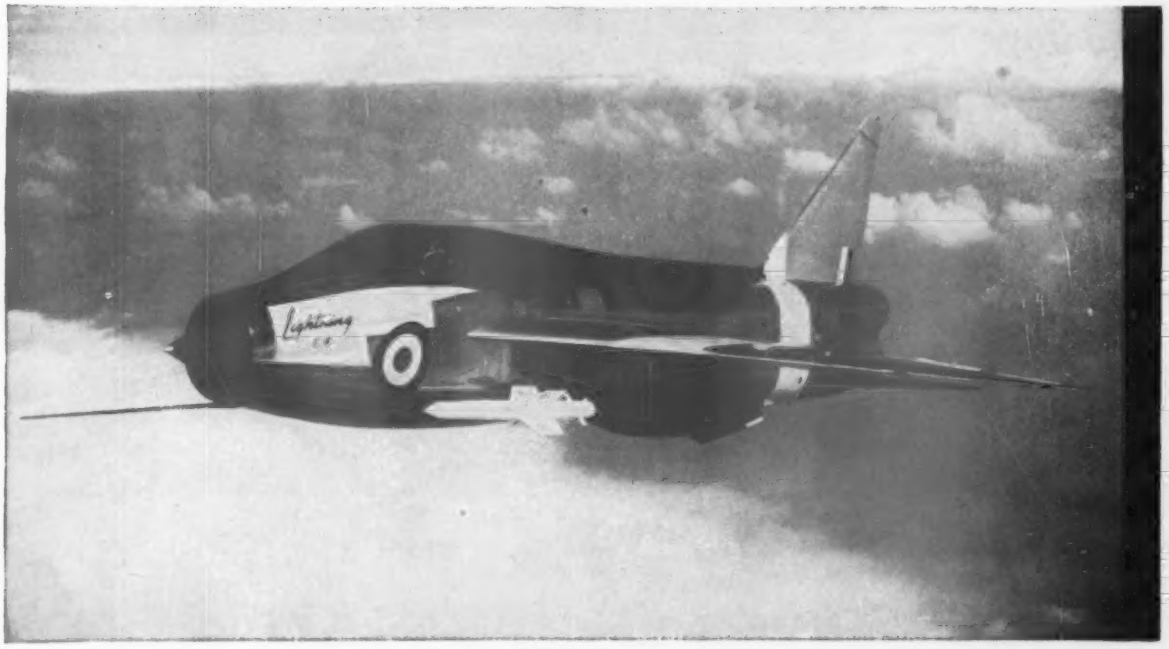
Vickers Vanguard
(above) Vandervell Bushes are fitted to flap mechanisms.

English Electric P.1. Supersonic Aircraft
(right) Vandervell Bushes are installed in actuating mechanisms for power assisted controls operating ailerons and tail plane.

Armstrong Whitworth Argosy Type AW 650 Freight-Liner
(below) Vandervell Bushes are fitted to pivot points on control mechanisms.



used in the aircraft industry



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(*Continued from page 346*)

suggested revised methods for the examination and selection of pupils for initial training and of captains.

Before the more esoteric aircraft systems of the future can be made safe and efficient, data on the use and misuse of present systems must be collected and analysed so that future systems can be less prospectively confusing or dangerous. This point was stressed by Mr. C. S. R. Marshall (Hawker Siddeley Aviation) who said that the design of semi-automatic systems would be aided by the formulation of human operating characteristics so that allowances could be made for these before reaching the air-test stage. Mr. Marshall, who was discussing human factors in supersonic aircraft design and operation, also mentioned the possibly deleterious effect on crew performances by the disruption of normal day/night rhythms, and those of eating and sleeping. Research was needed so that these effects could be understood. A human factors engineer should be included in the supersonic aircraft design team from the very start of the project.

Air. Cdre. W. J. Stewart (Consultant in Aviation Physiology, R.A.F.) pointed out that, although something was known about the reactions of small, picked Service crews to high-speed, high-altitude operations, nothing was known about the reactions of ordinary members of the public. Passengers might be flown in the supine position during the climb of a supersonic aircraft and nothing was known about the effects of this and of acceleration on people when, as in a windowless aircraft, they had no "real"-world references.

The problems to be overcome at the beginning of an era in which the capability of automatic systems is greater than that of the human pilot were discussed by Mr. A. M. A. Majendie (Smiths Aircraft Instruments). The correct functions of the pilot in this changed environment needed careful examination and study. The new systems, such as that for automatic landing, did not supplant the human pilot, but they required that his effort and overriding skill should be deployed in new and different ways.

Several speakers had assumed that, for pressurization security (which would need to be absolute at cruising levels of 60,000-70,000 ft.), supersonic transports would be windowless and at least one mentioned the difficulty of providing adequate emergency exits. Mr. Peter Masefield came out firmly with the opinion that a windowless aeroplane could never be sold to the public as a passenger vehicle. He also insisted that it would be "commercial suicide" to go for anything less than a Mach 3 transport. Although a Mach 2 project could be started now with the near-certainty of technical success, such an airliner would be overtaken too soon by the Mach 3 transport.

Mr. Masefield made a good (and near-medical) point when he backed this conviction with the opinion that a 3½-hour flight stage was just about the limit of comfortable passenger endurance. This, he said, was the "posterior limit" even with the best chair that medical ingenuity could devise.

Several papers described experiments in explosive decompression and oxygen deficiency, with pre- and post-inhalation of oxygen, or pre-medication. It is unlikely that the animals used in some of these experiments (mostly rats) were aware of their important rôle.

Aerobatic Instrument Training

The prevention of spatial disorientation in, and of instrument training for, high-speed, highly manœuvrable military aircraft were discussed in one paper. It was essential that absolute confidence should be engendered in the ability to control the aircraft on instruments in every possible combat situation and that transition between visual and instrument flight should be immediate and accurate. The pilot must be trained so that sensations of dizziness or vertigo are entirely suppressed or ignored. Instrument-flight training should be based on the assumption that visual flight will be the exception rather than the rule and training methods should make allowance for this fact.

Another speaker offered some new ideas about instrumentation, based on the fact that only the central part of the field of vision is sharply focused and has full colour perception. As explained, the proposed system appeared to be applicable more to industry than to aviation, but the principles might usefully be applied to instrumentation such as that on a power-plant or flight engineer's panel, where normal readings would show all-green dials and attention would be attracted by the appearance of red segments.

This Fifth European Congress of Aviation Medicine seems to have excited the right kind of interest at just the right moment for action to be taken in a hundred associated fields of research and study.

In an exhibition of specialized equipment associated with various aspects of aviation medicine, a number of companies were showing their products. Some of their displays are seen here. That on the bottom extreme left is Eastwood Plastics and next to it that of the Vacuum Reflex Co.

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The Fighting Services

Technical Training Command

AIR VICE-MARSHAL B. A. CHACKSFIELD, O.B.E., is to become Air Officer Commanding, No. 22 Group, Technical Training Command, on Sept. 12.

Taking over command of R.A.F. Waterbeach in 1954, Air Vice-Marshal Chacksfield later became Director of Guided Weapons at the Ministry of Supply. He completed the 1959 Imperial Defence College course and has been Senior Air Staff Officer at Headquarters, Technical Training Command, since January of this year.

Nato Air-to-Air Competition

FIGHTER COMMAND and R.A.F. Germany are among the eight NATO air force teams competing in this year's annual air-to-air firing competition sponsored by Allied Air Forces Central Europe. Being held in France between Sept. 5 and 17, the contest is the third in the series.

The Guynemer Trophy for the winning team and the U.S.A.F.E. Cup for the team finishing in second place will be presented by General M. Chelle, Commander, A.A.F.C.E. The other six teams are representing the First French Tactical Air Command, the Belgian Air Force, the 1st R.C.A.F. Air Division, the Royal Netherlands Air Force, and the French Air Defence Command.

Air Ministry Posting

GROUP CAPTAIN W. F. BECKWITH, C.B.E., has been appointed Director of Weapons Engineering at the Air Ministry, with the acting rank of Air Commodore. An engineering specialist, he was Chief Engineering Officer at Headquarters, F.E.A.F., before becoming Chief Training Officer at the R.A.F. Technical College, Henlow, in 1954. Air Cdre. Beckwith has just completed an exchange posting with the U.S.A.F. at Cape Canaveral.

No. 893 Squadron Commissions

ON Thursday of last week No. 893 Squadron, R.N., recommissioned at R.N.A.S. Yeovilton. Commanded by Lieut. Cdr. F. D. Stanley, R.N., and equipped with D.H. Sea Vixen FAW.1s, the Squadron is to embark early next year in the carrier "Centaur."

No. 893 was first formed at Donibristle in June, 1942, with six Martlet 1s. Some months later it was rearmed with 12 Martlet 4s and embarked in H.M.S. "Formidable" to take part in the North African landings as part of Force H. The Squadron provided fighter patrols for the Fleet during the landings and on Nov. 17, 1942, assisted in the destruction of U-boat U331, which was finally sunk by a torpedo from an Albacore from No. 820 Squadron.

For the next seven months the Squadron operated both from H.M.S. "Formidable" and from shore airfields in the Western Mediterranean, taking part in the Tunisian Campaign. In July and September of 1943 it provided fighter support for the Fleet during the Sicily and Salerno landings respectively. In October of that year it was transferred from the Mediterranean to the Arctic theatre and covered the returning North Russian Convoy R.A. 54A in November, 1943.

The second 893 Squadron formed in February, 1956, at R.N.A.S. Yeovilton with Sea Venom FAW.21s. Embarked in H.M.S. "Eagle" it took part in Operation Musketeer at Suez, and in its ground attack rôle accounted for 23 aircraft destroyed and 12 damaged. In September, 1948, it began the operational trials of the Firestreak AAM, which culminated in the first live firing of the weapon against a pilotless drone target by a carrier-based aircraft on Dec. 11, 1958.

In February, 1959, the Squadron re-equipped with Sea Venom FAW.22s and in September of that year went with H.M.S. "Victorious" on her successful tour of the major ports on the North American Atlantic seaboard. The second 893 Squadron was disbanded in February of this year.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

Air Ministry: Wg. Cdr. J. A. C. Aiken to the Department of the Chief of the Air Staff, with acting rank of Gp. Capt.; Wg. Cdr. A. V. Plowright to the Department of the Air Member for Personnel; Wg. Cdr. B. E. K. Pemberton-Piggott to the Department of the Air Member for Supply and Organization.

Bomber Command: Sqn. Ldr. F. C. Ellis to R.A.F. Driffield to Command the Administrative Wing with acting rank of Wg. Cdr.

Transport Command: Wg. Cdr. T. W. C. Fazan to R.A.F. Northolt to command the Administrative Wing.

Flying Training Command: Wg. Cdr. R. P. Harding to the Oxford University Air Squadron to command.

Technical Training Command: Gp. Capt. H. Stones to Headquarters as Senior Equipment Staff Officer.

Maintenance Command: Gp. Capt. N. Adams to Headquarters as Command Accountant; Gp. Capt. E. A. L. Wakely, O.B.E., to Headquarters, No. 40 Group, for operations duties; Wg. Cdr. J. R. Stowe to the R.A.F. Staff College, Andover, for directing staff duties.

R.A.F. Germany: Wg. Cdr. R. J. K. Baker, M.B.E., to Headquarters for organization duties; Wg. Cdr. S. Baker, D.S.O., D.F.C., to R.A.F. Gutersloh to command the Administrative Wing; Wg. Cdr. F. T. Bolt to R.A.F. Jever as Senior Technical Officer.

Far East Air Force: Wg. Cdr. J. L. Gilbert, D.F.C., to R.A.F. Changi to command No. 48 Squadron; Wg. Cdr. R. T. Morison, M.B.E., to Headquarters, No. 224 Group, as Senior Technical Staff Officer; Wg. Cdr. B. W. Taylor, D.F.C., to R.A.F. Seletar to command the Flying Wing.

Other Appointments: Gp. Capt. R. L. Wade, D.F.C., to Air Headquarters, Malta, as Senior Officer, Administration; Wg. Cdr. B. Champneys, D.F.C., to Amphibious Warfare Headquarters for staff duties; Wg. Cdr. D. L. Moir to Allied Air Forces Northern Europe for staff duties; Wg. Cdr. J. Quinn, D.F.C., to H.Q. Eastern Atlantic Area for Air Plans duties; Wg. Cdr. J. W. E. Holmes, D.F.C., A.F.C., to Bangkok as Air Attache.

Reunions

M.R.E.S. Reunion.—The 12th M.R.E.S. officers' reunion will be held in London on Saturday, Oct. 29. For full particulars please write, enclosing a stamped addressed envelope, to Sqn. Ldr. P. E. Laughton-Bramley, M.B.E., Haldon, Nightingale Road, West Horsley, Surrey.

No. 55 Squadron Reunion.—The 7th annual reunion of No. 55 Squadron will be held on Saturday, Oct. 22, at the Pathfinder Club, Mount Street, London, W.1. Tickets, price 7s. 6d. each, and further details may be obtained from I. Calverley, 38 Pondfield Crescent, St. Albans, Herts.

Specialist Navigation Association.—The inaugural meeting and dinner of the Specialist Navigation Association will be held at the R.A.F. Club, London, on Saturday, Nov. 19, starting at 18.30 hrs. Attendance is open to all specialist navigation graduates since the course started in 1919, and tickets, price £2 each, are available from Wg. Cdr. H. L. Lewis, R.A.F. Flying College, Manby, Louth, Lincs.

MARK TWO.—A photograph of the first production Avro Vulcan B.2 for Bomber Command which was delivered to No. 83 Squadron at R.A.F. Waddington at the beginning of July. Powered by four 17,000 lb. s.t. Bristol Siddeley Olympus 201s in place of the 13,000 lb. s.t. Olympus 104s of the Mk. 1 Vulcans, it has an extended rear fuselage containing electronic equipment.

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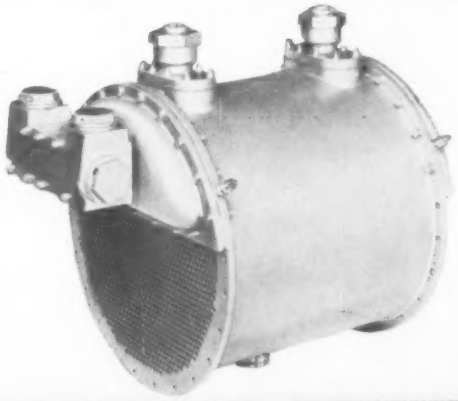

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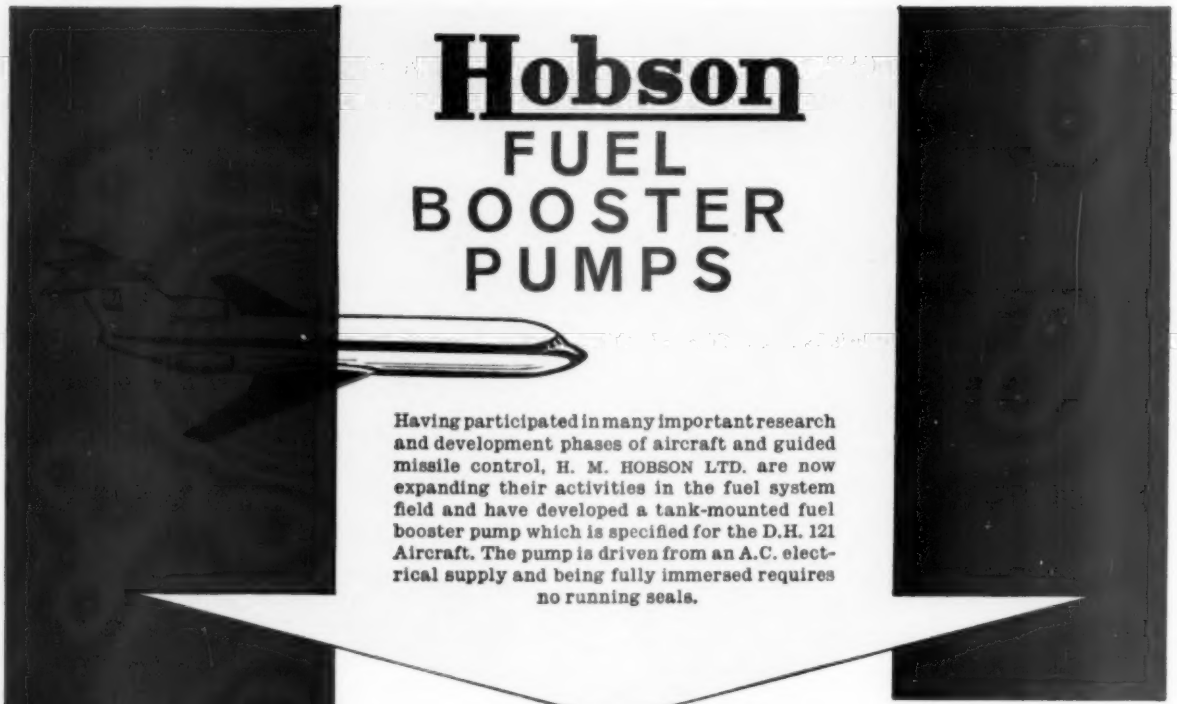

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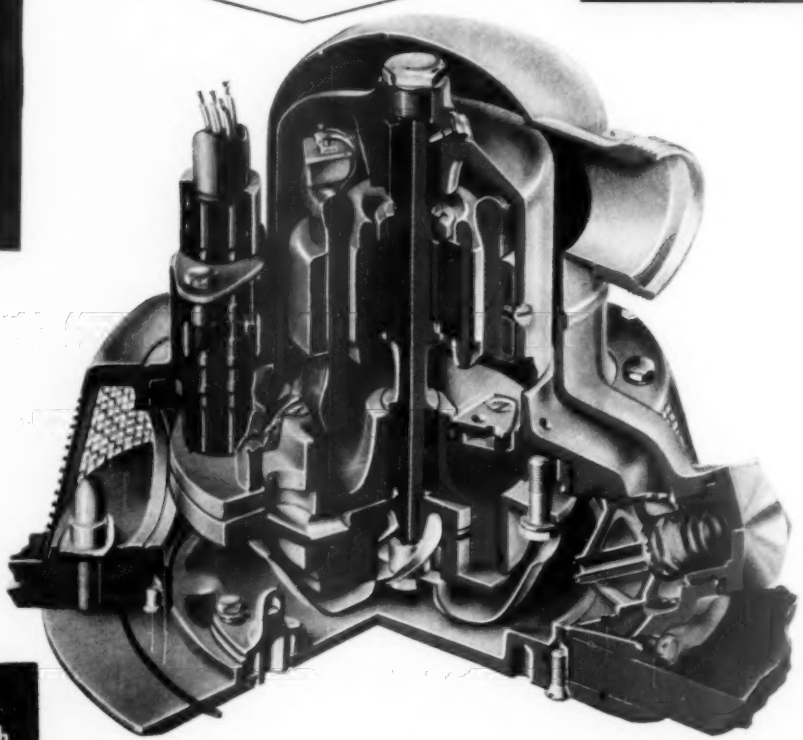

S.B.A.C. Exhibition and Flying Display Farnborough Sept. 5th — 11th, 1960

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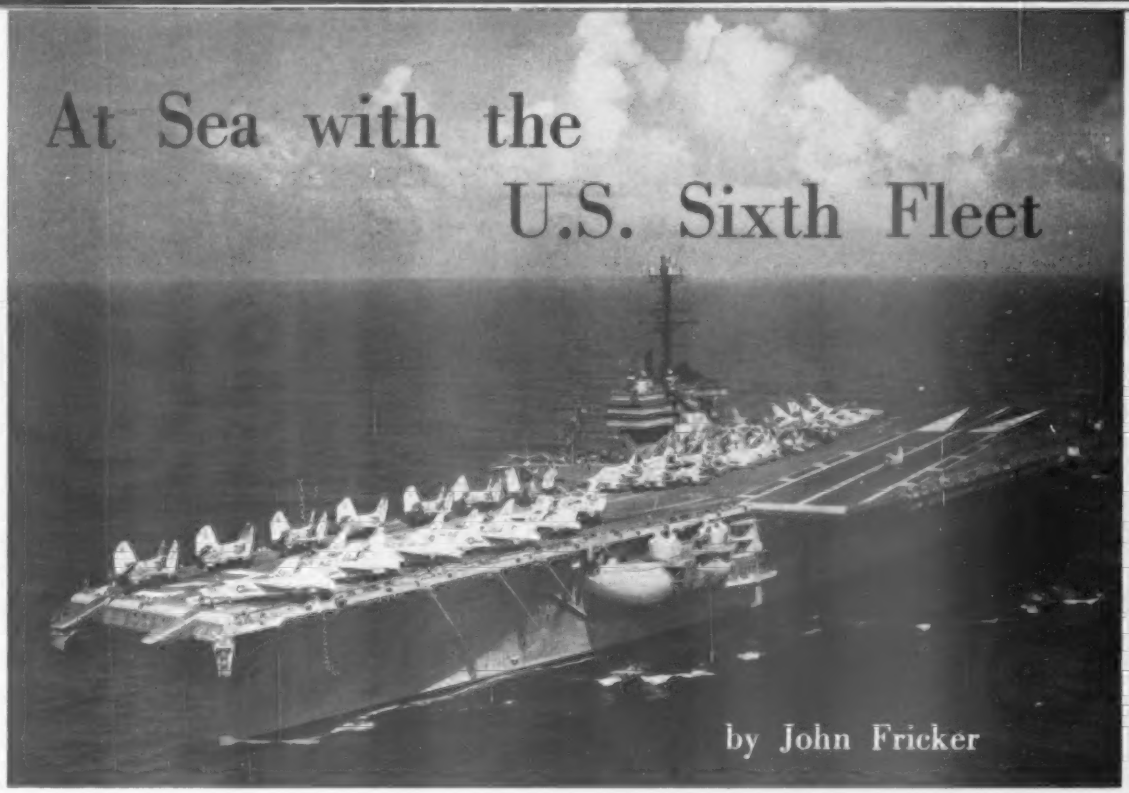
At Sea with the U.S. Sixth Fleet



by John Fricker

Newest U.S.N. carrier in commission and spearhead of the Sixth Fleet is the 75,000-ton "Independence."

FAR off, on our starboard side, just visible through the tiny portholes of our Grumman TF-1 Trader fleet logistics aircraft, the sun-soaked sands of the Côte d'Azur receded into the morning heat-haze. Some 8,000 ft. beneath us, the Mediterranean had on a smiling, barely wrinkled face, reflecting the deep sapphire of an unclouded sky, which we traversed at 150 knots for our rendezvous with the U.S. Sixth Fleet.

Our objective was the four-acre flight deck of the U.S.S. "Independence" (CVA-62), latest of the four 75,000-ton "super-carriers" to enter service with the U.S. Navy, and the nucleus of Sixth Fleet striking power. The atomic simile is appropriate for this highly mobile nuclear deterrent force, which knows no base on the shores of the sea it guards. For this reason, a visit such as ours almost inevitably has a deck-landing prelude, plus an appropriately similar termination, but both processes are rendered uneventful by the tractable twin-engined Trader.

"Rip Van Winkle, Lt. Cdr." said our pilot's name-tag, although his alertness in flight belied the inevitable association of ideas. In accordance with the best traditions of security, we were not proceeding directly towards the massive ship, which was steaming somewhere off the island of Majorca, but were flying an offset course from Nice over 277 miles of empty Mediterranean.

A vast operating area and almost continual movement of the ships combine to make one of the most effective possible defences for the Sixth Fleet. Knowing the approximate position of the "Independence," we had a rather simpler navigational problem, which was made completely effortless by the standard U.S. Navy TACAN UHF system. After intermittent reception of the ship's beacon at extreme range, the radio-compass type heading presentation finally locked on to point the way when a distance of 138 n.m. was indicated on the separate "miles-to-go" veeder indicator.

While the sturdy TF-1 thundered on, I reflected in my rearward-facing seat on the utility of these COD-flights, or "carrier-on delivery" service operated by Squadron VR-24 from Naples, and wondered what the Royal Navy uses for landing freight, mail and bulk loads on flight decks now that the Ganhet's capacious bomb bay is no longer available. In place of the extensive electronic gear in the S2F Tracker version of the Grumman twin, the TF fuselage, ill-lit as it is by improvised portholes which are overhung by the big engine nacelles, can carry up to nine passengers, or a ton of freight loaded through large double doors at the rear.

The lack of passenger visibility did not permit much of the deck-landing process to be seen but, with shoulder harness secured, we jerked to a stop on the broad steel deck of the "Independence" with remarkably little fuss. On emerging into the sunlight below the folded wings of our erstwhile transport in the forward deck park, we had just sufficient time to notice a seemingly innumerable collection of ultra-modern aircraft, all armed to the teeth with unmistakably live bombs, rockets and missiles, before we were hustled below for the first of many high-powered briefings.

From the 35-knot-breezed sunshine and controlled confusion of the flight deck to the air-conditioned efficiency below was a transition bringing a rapid reminder of the environment in which most of the 4,000 people on a super-carrier exist. Because of atomic contamination dangers, portholes are a thing of the past, and very many members of the crew spend days without seeing daylight, or knowing whether it is morning, noon or night outside. All exposed areas of the ship are covered by a sprinkler system to wash off radiation-contaminated matter.

Commander of the Sixth Fleet is Vice-Admiral George W. Anderson, Jr., who has joint national and NATO responsibilities to the C-in-C. U.S. Naval Forces, Europe (CINCUSNAVEUR) in London, and the C.-in-C., Allied Forces, Southern Europe (CINCSOUTH) in Naples, respectively. When the Sixth Fleet operates in its NATO capacity, it is known as Naval Striking and Support Forces, Southern Europe, and Vice-Admiral Anderson becomes COMSTRIKFORSOUTH in the Nato jargon. For that job, he has a second staff based at Naples administered by his NATO deputy.

Admiral Anderson himself is always afloat, based on his flagship, the cruiser "Des Moines." He was on "Independence" to welcome us, however, and to sketch in an outline of fleet organization. The 54-year-old Admiral is tall, burly, and tanned, with iron-grey hair. Precise in speech and relaxed, he told us that since taking over his present command in August last year he had "never been so busy, or had so fascinating a job."

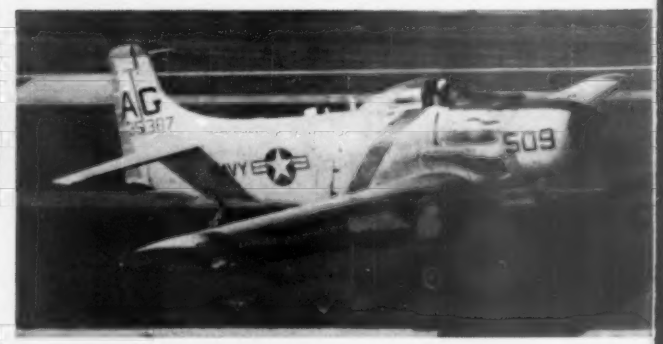
The composition of the fleet changes completely every four to six months, with ships from the U.S. replacing those in the Mediterranean. The Admiral explained that they had just gone through the process of "changing watch," and the "Independence" had just come out to replace the "Forrestal." He also revealed that with the other carrier in the Sixth Fleet, the Essex-class "Intrepid," a third attack vessel, the massive "Saratoga" was on its way from the east coast of the United States, to supplement American striking power in the Mediterranean.

These three very powerful ships (Carrier Division Two), together with two cruisers and about 20 destroyers form an Attack Carrier Striking Force, or Task Force 60, which is the highly potent spearhead of the Sixth Fleet. It comprises half the number of ships in that fleet, which also includes some 25,000 personnel and nearly 300 aircraft. The CVA Striking Force has high-speed jet fighters and bombers in its armoury with an operating radius of more than 1,000 miles, and is equipped for all-weather operation.

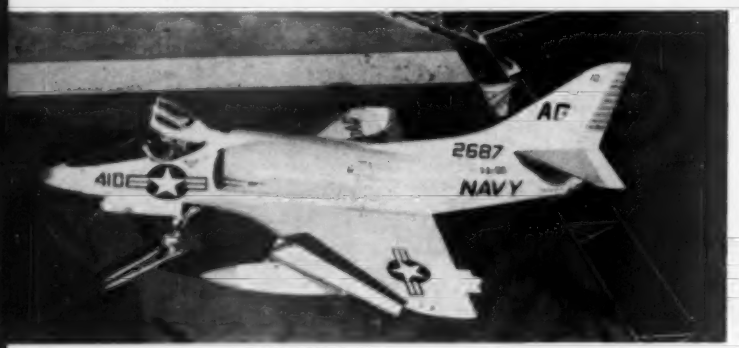
It is backed by an Amphibious Force (Task Force 61), with appropriate vessels and a reinforced battalion of 1,800 helicopter-equipped (S-58) U.S. Marines, and a Service Force

(*Continued on page 352*)

Above, for all-weather fighting, the "Independence" is equipped with McDonnell F3H-2 Demons, armed with four 20 mm. cannon and Raytheon Sparrow III radar-homing air-to-air missiles.



Two versions of the versatile Douglas Skyraider are the single-seat AD-6 (above), seen here with a maximum 9,000 lb. load of 15 H.E. bombs, and the multi-seat AD-5Q (below), carrying radar, extra fuel and many other odd items for special duties.



Above, the Douglas A4D-2 Skyhawk is a lightweight attack aircraft packing a nuclear punch, and equips two squadrons on "Independence." Carrier-on delivery is performed (below) by Grumman TF-1 Traders of Squadron VR-24.

Below, the four-acre flight deck on the U.S. super-carrier is slightly congested with only half the aircraft complement deployed. Identifiable are WF Tracers, A4D Skyhawks, F8U-1 and -2 Crusaders, AD-6 Skyraiders, F3H Demons and A3D Skywarriors, all armed for take-off. The A3Ds are positioned on the angled catapults, with blast deflectors extended behind them.

Air Power on the U.S.S. "Independence"

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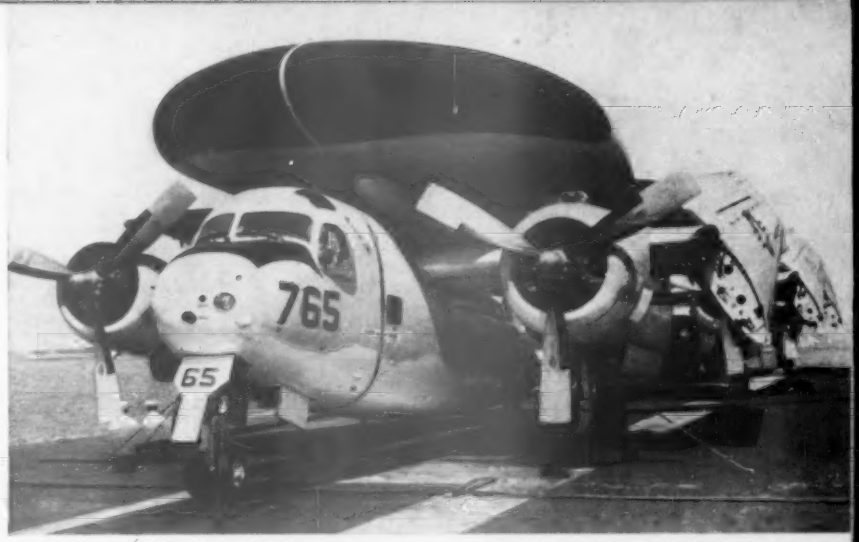
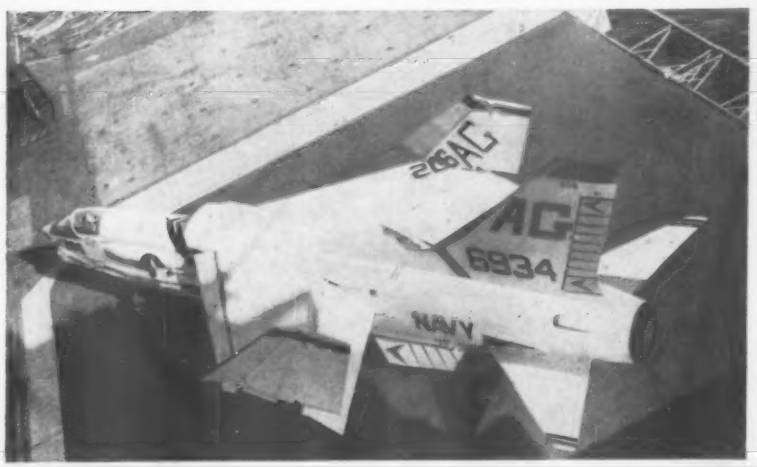


Above, christened "flying saucers," the A.E.W. Tracers are yet another version of the Grumman S2F and recently arrived in the Sixth Fleet on "Independence." Search radar is carried in their enormous radomes, and they are fitted with twin fins and rudders. Commander of the mighty U.S. Sixth Fleet (left) is Vice Admiral George Anderson, Jr.



The Chance-Vought F8U-2 (above and left) is an advanced version of the M=1.7 Crusader equipped with radar and armed with four 20 mm. cannon and Sidewinder missiles. It has a variable-incidence wing and flight refuelling equipment in the port fuselage. As a Crusader and a big A3D Skywarrior line up on the bow catapults of "Independence," (below) another F8U climbs away after an accelerated launch from the angled deck.

(*Continued from page 349*)

(Task Force 63), of auxiliary ships such as tankers, repair and supply vessels. These form a floating base to keep the fleet at sea for indefinite periods, and to maintain its complete mobility and self-sustenation. About 50% of the time on station is spent at sea, in vigorous combined exercises, while the remainder is occupied in visiting about 100 Mediterranean ports.

In addition to the three major forces, the fleet is supported by land-based aircraft for scouting and anti-submarine operations, and by submarines, principally to provide training services. It will be noted that the Sixth Fleet has no integral anti-submarine component, nor are its ship-based aircraft equipped for this duty, except as a secondary rôle. Periodically and in time of crisis, however, the fleet is augmented by an Anti-Submarine Force (Task Force 66), with a specialized carrier air group accompanied by destroyers, for such operations. A permanent a/s force would be a valuable addition.

Apart from its primary function of complementing the fixed-base NATO deterrent, a responsibility whose weight will be only slightly relieved by the imminent advent of the Polaris-equipped submarines, "George Washington" and "Patrick Henry" into service, the Sixth Fleet provides the naval-support and strike force for the S. Europe command armies of Italy, Greece and Turkey. Exercises with these forces occupy much of the training schedule, while cross-operations with the Royal Navy in the Mediterranean are also frequent.

Admiral Anderson mentioned that a week before our visit, his aircraft had flown on to the decks of H.M.S. "Hermes" and "Ark Royal," which were under the command of Rear Admiral R. M. Smeeton, M.B.E., R.N. British Scimitars and Sea Vixens had also operated from "Independence" and "Intrepid," and both navies had controlled each other's aircraft.

In the fighter control phase, the U.S.N. had greatly admired the "3-D" Type 984 radar of the "Hermes," although the "Independence" is hardly ill-served by its SPS-17 long-range air search radar, with a 40-ft. wide scanner, SPS-12 medium-range air search radar, SPS-8B altitude determination radar, SPS-10 surface search radar and ECM equipment. Covetous glances, on the other hand, were bestowed by the R.N. on the highly advanced aircraft of the Sixth Fleet.

On the "Independence," these comprised 90 machines of 10 different types, forming overall the Seventh Carrier Air Group. This is made up of two all-weather fighter squadrons, VF-41, with 14 Sparrow III AAM-armed McDonnell F3H-2 Demons, and VF-84, with 14 Sidewinder AAM-armed Chance Vought F8U-2 Crusaders; three light attack squadrons, VA-72 and VA-86, each with 12 Douglas A4D-2 Skyhawks, and VA-75, with 12 piston-engined Douglas AD-6 Skyraiders; and one heavy attack squadron, VAH-1, with 12 of the massive twin-jet Douglas A3D-2 Skywarriors. Primary armament of these bombers except the ADs are nuclear weapons, which all can deliver by semi-aerobatic loft bombing with L.A.B.S. (low-altitude bombing system). They can also deliver the Martin Bullpup air-to-surface missile, the Zuni high-velocity rocket, and conventional high-explosive weapons.

Completing the aircraft on "Independence" are "splinter" detachments for miscellaneous duties. These comprise three Chance Vought F8U-1Ps of VFP-62 for tactical reconnaissance duties; five Grumman WF-2 Tracers of VAW-33, with their enormous dorsal radomes, for airborne early warning; three Douglas AD-5Q Skyraiders of VAW-12 for radar and special duties; a single Grumman TF-1 Trader for logistics support; and two Vertol HUP-2 Retrievers for plane-guard, communications and many other operations.

With this formidable complement, and its stowage, handling and maintenance facilities for the Sidewinder, Sparrow III and Bullpup guided missiles, the "Independence" alone can mount a potent striking force. This was rapidly demonstrated to us when half the ship's aircraft were launched for a fire-power display, carrying live ammunition.

For 17 minutes, the flight deck was an inferno of noise, smoke and fury, as 40 aircraft were blasted off at 26-second intervals from the four steam catapults—twice the number on R.N. ships—or made free take-offs, in the case of the piston-engined Skyraiders. With 268-ft. catapults on both the angled and axial portions of the flight deck, capable of accelerating aircraft up to 90,000 lb. in weight, and with end speeds of 120-140 knots, a high launching rate is achieved without the assistance of the Royal Navy's auto-centring and positioning rollers. These line the aircraft up rapidly and accurately over the catapult shoe, instead of the precise steering needed from U.S. pilots when taxi-ing. The A4D Skyhawks have non-steerable nosewheels, and are lined up by a ground handler.

These aids are among the few R.N. items still to be adopted by the U.S.N., which offers generous acknowledgment to the British developments of the angled deck, steam catapult and deck-landing mirror sight, now standardized on American attack carriers. As we heard from Rear Admiral Ray C. Needham, U.S.N., commander of the Sixth Fleet's CarDiv 2, all but one (the "Valley Forge") of the 14 U.S.N. attack carriers in commission have angled decks, although some of the seven "Essex" class still have hydraulic catapults. There are additionally nine specialized anti-submarine carriers in service, with Grumman S2F Trackers and various helicopters, while three further carriers carrying assault helicopters alone bring the total number in U.S.N. service to no fewer than 26. Two more super-carriers will join the fleet next year, followed by the nuclear-powered $300 million, 82,000-ton "Enterprise."

Meanwhile, on the newest U.S.N. carrier, we watched the big Douglas A3D bombers lead off, after the two little tandem-rotor Vertol helicopters, or "angels" as the Americans call them had taken up their sideways-flying stations on the starboard side of the ship. With twin plumes of black JP 5 smoke battering at the jet blast deflectors raised from the deck, the A3Ds strained at the hold-back bridles before slipping along the catapult track and off the bows in a wake of expended steam, their top hatches open until airborne, in case of ditching.

To this Mephistophelean setting of smoke and steam, barred by the radar-shadowed sunlight, and coloured by the bright blues, greens and yellows of the flight deck crews, was added the piercing thunder of the orange-flamed afterburners on the Crusaders as they took their tilt-winged way into the air. With their mainplanes cocked at a high incidence and, like all the U.S.N. jet designs, having leading-edge slats extended, the F8Us joined the A3Ds, A4Ds and F3Hs in formation over the ship as it bored on at an inexorable 30 knots through a mill-pond Mediterranean.

Last to take the air were the lumbering ADs, referred to, slightly unkindly, as "Spads" by the jet pilots, but capable of lifting prodigious loads over extraordinary distances. Their reputation as aerial arsenals during the Korean War is still spoken of with awe, especially by the Marine Corps, and Admiral Needham confessed his reluctance to see them go, when they are eventually replaced by the twin-jet Grumman A2F Intruder. Their weight-lifting and endurance capabilities are put to good use by the U.S.N., which in addition to their many other duties, uses one as a safety tanker during deck-landing operations, carrying emergency fuel for thirsty jets.

Sixth Fleet in Action

Mutual confidence in accuracy of attack was shown during the next half-hour or so, when the sea in close proximity to the ship heaved and boiled under a rain of high explosive. Many of the bombs were released during loft manœuvres, and were tossed in high arcs, seemingly right overhead, before plunging down close alongside. First, however, an A3D led in two A4Ds for a demonstration of level bombing, using the pathfinder technique to permit the Skyhawks to attack a target simultaneously with the Skywarrior in non-contact weather, by means of the larger aircraft's electronic equipment.

The first L.A.B.S. manœuvre was completed by an A3D, in which loft bombing had been pioneered by Cmdr. H. F. Lang of "Independence." The procedure for this is an approach at very low altitude and 500 knots to an I.P. (initial point) some distance such as five miles from the target. A 45° pull-up is started and maintained at 2.5 *g*, the nuclear weapon being released at a predetermined angle (48° during the demonstration), while the aircraft continues over in a 120° bank to a peak of 8-9,000 ft. to fly in the opposite direction and escape the blast of the explosion.

Equally spectacular was a L.A.B.S. run by an AD-6 Skyraider, which because of its slower speed (275 knots at max. power) used a rocket-assisted weapon of a smaller yield, fitted for the demonstration with a conventional explosive warhead. It is necessary to pull almost twice the *g*-load of the A3D in the Skyraider, which must be handled with some care to stay within its flight envelope. All the same, it was rather startling to see the AD complete its L.A.B.S. manœuvre with a neat roll off the top of a loop.

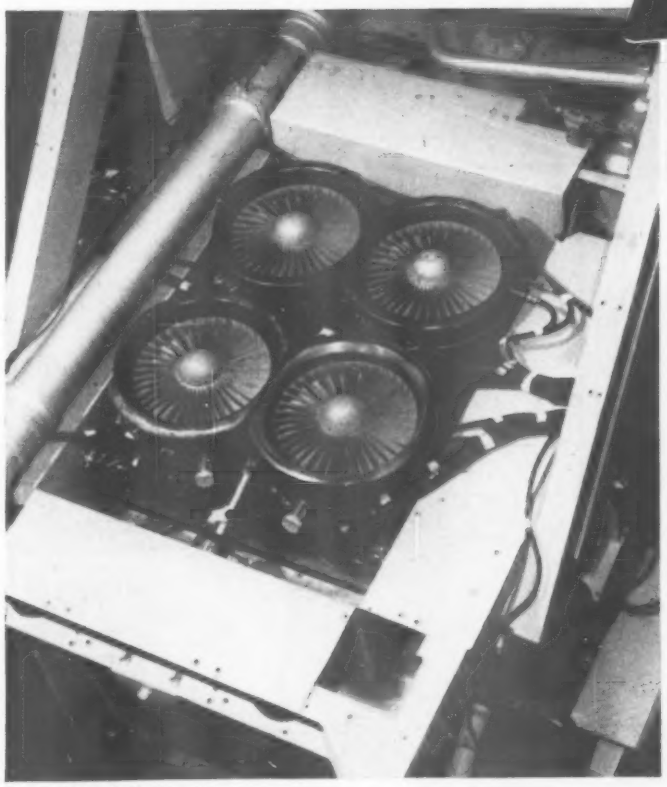
Four A3Ds demonstrated another aspect of their utility with a display of low-level mining, and an AD-6 then dropped two parachute flares as targets for Sidewinder-armed Crusaders—not with any noticeable success. Several A4Ds showed the enormous arc over which bombs could be lobbed when released in a vertical climb and, in quick succession, a splash target towed behind the stern of "Independence" was blanketed by F3H Demons firing 2.75 in. Mighty Mouse rockets, A4Ds launching Zuni rockets, and F8Us and F3Hs firing their 20 mm. cannon.

An AD-6 emptied 114 Mighty Mice on to the same target in one salvo, and two other ADs, each carrying their maximum load of 12 500-lb. and three 1,000-lb. bombs, dumped them in an intimidating steep dive attack just behind the flight deck. It was left to the F8U Crusader to provide the grand finale, two of the tactical reconnaissance versions leaving a trail of brilliant photoflash bursts as they looped rapidly overhead, while a fighter made a run at exactly M=1, to deposit a thunderous double crack over the ship.

(*To be concluded*)

V.T.O.L

WITH ROLLS-ROYCE ENGINES



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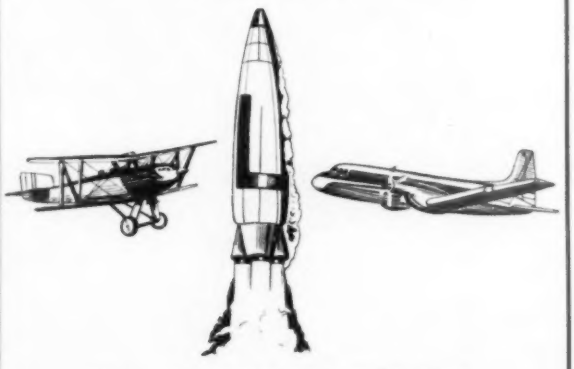

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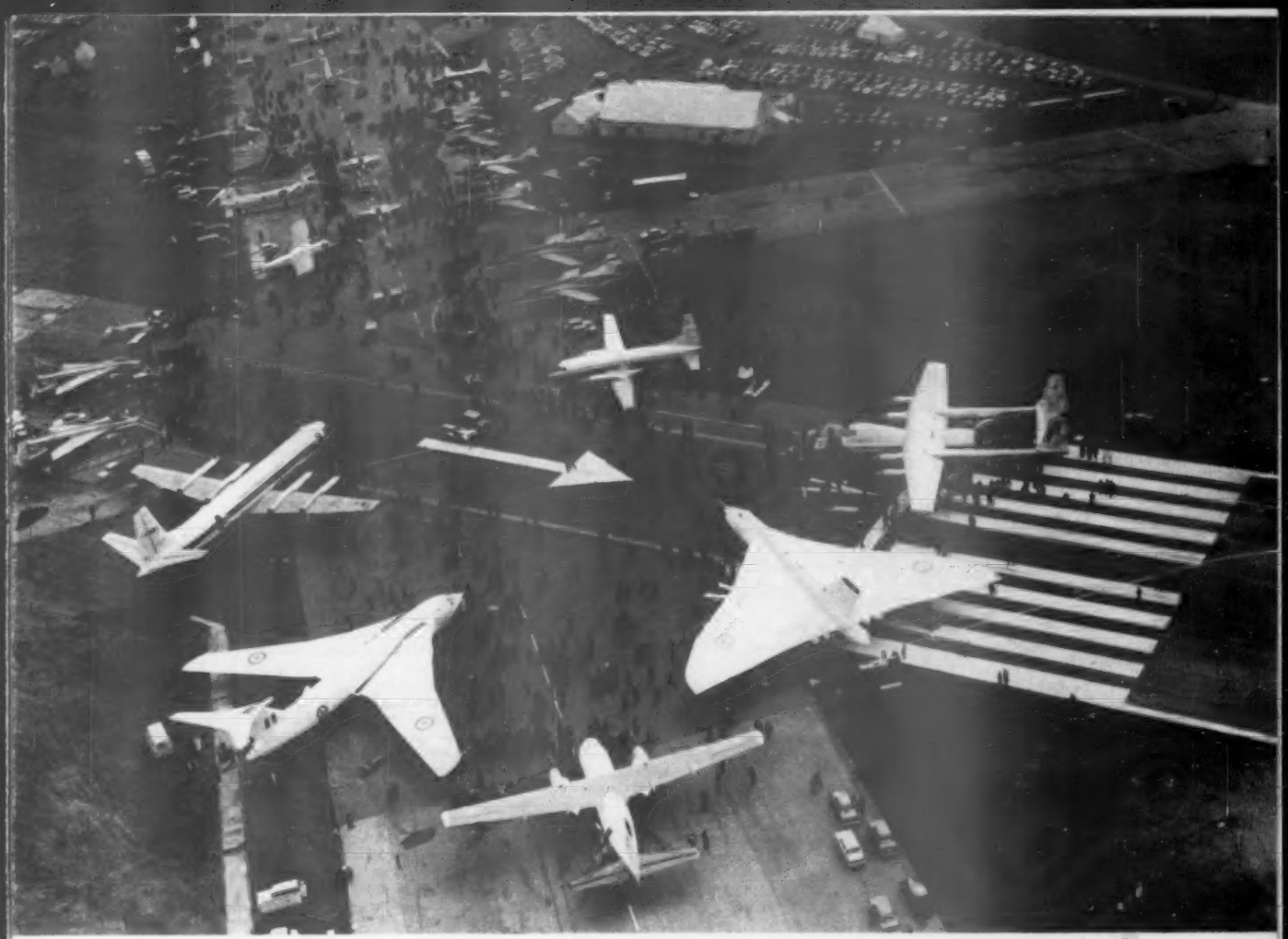
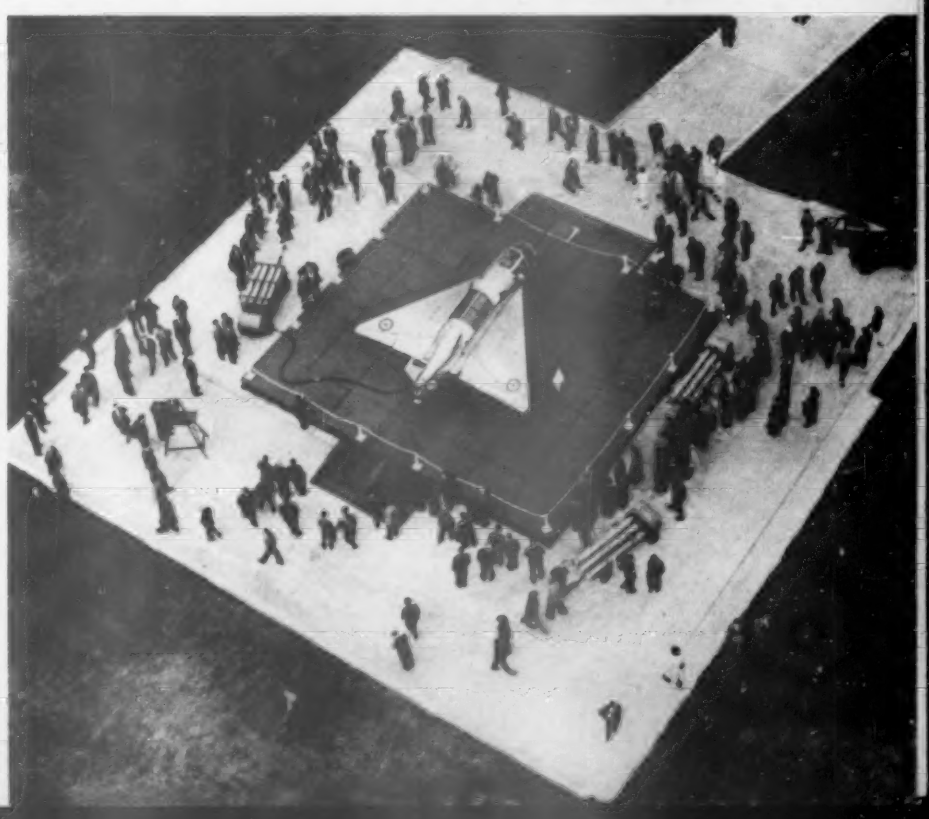


TWENTY-FIRST ANNIVERSARY

IN each of the twenty-one shows which have been held by the Society of British Aircraft Constructors since the first at Hendon in 1932 there have been significant exhibits and prototypes which have lead the way into new fields of development.

There have been plenty of thrills. There has been colour and splendour and ever-increasing power. But never, we are sure, any demonstration of greater significance than that given by Tom Brooke-Smith in the Short SC.1. The unhurried performance of the Rolls-Royce engined flat riser, the complete control by the pilot as shown by positioning and effortless turns changing into high-speed flight, made clear to everyone watching that the business of flying has entered a new era. Combined work by the engine designer and by the aircraft designer has shown that aircraft of any speed whatever can be built to be independent of the surface whether for take-off or alighting. As is well-known the next step behind the Short SC.1 is the Hawker P.1127, Bristol Siddeley, the power plant of which was on show and attracting much attention. This promises to make the first step into military application of the vertical take-off principle.



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PIRATE'S PLAN.—Many interesting details of the Blackburn Buccaneer, including its open rotary weapons bay, are apparent as it presents its plan view.

Report from Farnborough . . .

The Flying Programme Described

Photographs copyright "The Aeroplane and Astronautics"

UNRIVALLED HIGHLIGHT of the 21st S.B.A.C. flying display, which otherwise contains relatively little in technical novelty, is the supremacy in practical VTOL flight demonstrated daily by the Short SC.1. Reports of its successful transitions, now totalling something like 100 in number, have provided ample proof in recent months of flat-riser practicability, but the first public showing of its extraordinary capabilities is more convincing and impressive than any story can be.

The SC.1 rises on its shimmering lift-engine efflux as a symbol of significant progression towards the ideal of automatic VTOL operation for nearly all types of civil and military aircraft. Its three-axis, three-channel auto-stabilisation system has simultaneously facilitated the solution of the many complex problems of stability and control at zero airspeeds with those of linking-in electronic equipment for automatic landing.

The reliability pattern of the triple-channel, auto-stabiliser will be further tested during the next phase of flight development by R.A.E. Bedford, but the fact that only a couple of genuine failures in one channel have so far been encountered is an encouraging prospect for the future. In the meantime, no finer finale to a spectacular flying career can be imagined than the present SC.1 demonstrations by Tom Brooke-Smith.

After starting the four 2,100-lb RB. 108 lift engines and the single propulsion unit, with the aircraft on a very low platform in the centre of the airfield, he lifts the SC.1 vertically off with very little fuss, although the noise level seems to increase noticeably as the aircraft rises to the hover. Its steadiness and apparent precision of control, via the extremity "puff-pipes," are most impressive, and its on-the-spot manœuvrability compares very favourably with most helicopters.

Equally notable, the very high rate of acceleration during the rapid transition to forward flight, aided by the substantial thrust increment of the 30° tilted lift engines. Transition is being performed daily at no more than 50 ft., and at a completely unchanged altitude, which is one of the most important features for its practical application. In a wide circuit of the airfield, the SC.1 is soon flying at something approaching 300 m.p.h., which also brings home the advantages of jet lift over rotary wings for vertical flight in the most obvious way.

The return to the hover is equally uneventful, although the increase in noise level is again apparent as the SC.1 sweeps in, and the lift engines begin taking over the job of supplanting wing lift. Deceleration is quite quick, and from the hover, the SC.1 sits gently down on the runway, before taxy-ing away like a conventional aeroplane.

Flat-rising continued to be the dominant theme of the display opening, with the inspection of the B.S.53-powered Hawker 1127 by American and N.A.T.O. air force personnel at Dunsfold, and the hurried withdrawal from the Bristol Siddeley stand of a sketch showing an unknown airframe described as a typical B.S.53 installation. Coincident with this came news of a possible VTOL development of the Armstrong Whitworth Argosy, powered by two Rolls-Royce Tyne turboprops in place of the existing inboard Darts, and a cluster of small Rolls-Royce lift engines (with thrust/weight ratios exceeding 14:1) in the outboard positions.

Another new aspect of the Argosy was shown publicly for the first time on Tuesday in the flying display, when the aircraft with the A.W. 660 rear clamshell doors flew over to demonstrate their opening in the air. G-APRN is flying daily in the programme, and is representative of the 10 civil A.W. 650s (7 Riddle, 3 B.E.A.) which are being ordered. Announcement of a further 16 A.W. 660s for R.A.F. Transport Command, making 56 military types in all, brings the Argosy to the threshold of its break-even figure within a year of the first order.

Equally encouraging in the flying programme is the spirited demonstration of the Avro 748 prototype, which looks right, and seems to handle with extreme ease in its tree-top circuits of Farnborough. As the only completely new type in the display, it is naturally attracting a great deal of attention, and its very short take-off and landing—the latter without reverse-pitch—caused much favourable comment on the opening day.

It was the privilege of R.A.F. Bomber Command to open the

TUESDAY FLY-PAST.—The military version of the A.W.A. Argosy, the A.W. 660, flies past with its crocodile-jaw rear loading doors open.

Monday programme with their V-bomber scramble from cockpit readiness, and four Valiants of No. 148 Squadron (Wg. Cdr. D. C. Lowe, D.F.C., A.F.C.) were duly lined up obliquely on the runway threshold as Oliver Stewart began his introduction. A special landline links the aircraft directly to H.Q. Bomber Command, from which the C-in-C can talk to any of the aircraft captains, and from the scramble order, the four Valiants were airborne in a remarkable 1 min. 56 sec. Vulcans of No. 617 Sqn. (Wg. Cdr. L. A. G. Bastard, A.F.C.), took over on Tuesday, and were scheduled to alternate with No. 15 Sqn. Victors (Wg. Cdr. J. G. Matthews, A.F.C.) and the Valiants.

R.A.F. participation accounts for some 30 min. of the 2½ hr. programme. It includes the take-off and return of 201 Sqn. (Wg. Cdr. A. C. Davies) Shackleton 3s to and from a 22-hr. patrol over the Atlantic (with the A.O.C. No 19 Gp., Coastal Command on board the first one on Monday); the well-known C.F.S. Jet Provost 3 team (Flt. Lt. R. Langstaff); four Lightning F.1s of No. 74 Sqn (Sqn. Ldr. J. F. G. Howe); and of course the incomparable Black Arrows of No. 111 Sqn.

Many other highlights provide a memorable spectacle in the display, ranging from the mushing, spine-cracking high-*g* turns of the Firestreak-carrying Lightning F.1 and T.4, and the tiny Gnat Trainers, through the twinkling rolls of the store or tank-carrying Sea Vixen, Hunter 10 and Javelin 9, to the majestic handling of the big types such as the Victor 2 and the Vanguard. The lighter transports—Dove 8, Twin Pioneer 3 and Herald—are also there: the Handley Page twin takes-off and lands between two tapes, only 600 yd. apart, and with 30 troops on board. On Tuesday a firm order for six Heralds by Jersey Airways was announced.

Other impressions remain in the mind's eye after Monday's programme in autumnal sunshine and cloud, the latter blanketing Bill Bedford's corkscrew smoke trail as he spun the Hunter T.66 down from 15,000 ft. in a long, long, 13-turn sequence. The Day-Glo trainer-marked Jet Provost T.4, now ordered in quantity for the R.A.F., included a five-turn spin in its display, and showed the excellent acceleration and climb conferred by its more powerful Viper B.S.V.11. The power excess of the Vulcan B.2 is even more apparent, as it stands on the four black columns of smoke from its Olympi in an almost vertical climb from a very short take-off.

Blackburn's two Buccaneers take-off in formation like unleashed greyhounds, with tiny blown flaps and long drooping ailerons giving them high-cambered wings. They also land in opposite directions, crossing on the runway. An excellent speed range, a very high rate of roll, and a rotary weapons bay door displayed for the first time—what more could one ask from the Navy's nuclear strike aircraft?

Perhaps the only thing one could demand from the Westland circus, which appears this year under the same "big top" for the first time, was the inclusion of the Rotodyne on the opening day. It was prevented from arriving, through minor unserviceability, until Tuesday, but in its absence, the stage was very well held by the big faired-Westminster, the short-cabin naval and long-cabin Army Sprites, the Turmo-Skeeter, the Wessex (over the vertical stall-turned as usual by Bradley), the Whirlwind 10, and the straight-tailplaned Belvedere.—J.E.F.

WESTLANDS ALL.—Included in the Westland circus this year are (*left to right*) the Westminster, with faired fuselage and new tailplane, the Wessex, the Whirlwind 10, the Army Sprite, the Navy Sprite and, hardly visible, the Turmo-Skeeter. Missing is the Rotodyne, which flew over on Tuesday.

STAR TURN.—*Right:* Apart from demonstrating, for the first time in public, full transition, the SC.1 showed convincingly its ability to take off and land vertically. It is here poised over the runway.

LOW AND SLOW.—The Handley Page Victor B.2 makes a very low fly-past, with leading-edge flaps drooped.

Report from Farnborough . . .

Round the Electronics Stands

TRENDS in the application of electronics in the aircraft and allied fields as evidenced by the exhibits at this year's S.B.A.C. show, appear to reflect the mood of the industries themselves—that is, one of cautious optimism. Whilst there are few indications of outstanding or startling developments it is nevertheless clear that manufacturers have considered worthwhile a determined attack upon some of electronics' besetting devils, in particular that of lack of reliability, at the same time devoting a reasonable amount of effort to the design and production of new equipment.

The place of electronics remains roughly what it has been for some years, namely, in the fields of radar, navigational aids, ground-to-air and air-to-air communications, autopilots and other automatic controls to mention those directly concerned with the flying of aircraft. Connected more with the laboratory and flight development, testing and manufacture, are the fields of computation, both digital and analogue and data handling, and for the training of pilots, radar operators, ground controllers, etc., there are the various forms of simulator.

Probably the most noticeable of the rather ill-defined trends this year is that towards the use of more and more transistors in every situation where it is feasible technically to do so. For those unacquainted with the particular merits of the transistor it may be as well to point out that, compared with its predecessor the thermionic valve, it requires no heater power to be supplied to it and generally operates at a lower level of power dissipation—with the result that the total amount of heat generated by a typical unit containing a number of transistors and other components is only about one-tenth of that generated by the equivalent unit built with thermionic valves.

As the removal of surplus heat has always been one of the major difficulties in compact electronic equipment the advantage is self-evident. In the past even the use of fans, bulky in themselves, has led to the further drawback that they tend to draw dust into the equipment and thus impair its operation.

Other outstanding advantages of the transistor are its small physical size and its high resistance to mechanical shock. Both these features are of great interest to designers attempting to create compact, reliable units for operation under severe service conditions.

The main difficulties up to now in the introduction of transistors into the wide range of electronic equipment have been their sensitivity to high temperatures and their inability to handle the very high frequencies which are essential in certain applications, particularly radio and radar. However, improvements in the design and manufacturing techniques of transistors have produced many remarkable new types which are now making their appearance in commercial equipment, examples of which are mentioned in the following paragraphs.

This long-range telemetry sender for guided missile applications is a dominant item of interest on the General Electric Co., Electronics Division, stand.

Radar and Navigational Aids

One radar system to make good use of transistors is the Ekco lightweight weather radar. The latest version of this is not only engineered with as many valves replaced by transistors as possible, but further to improve reliability it has been provided with duplicate transmitter/receivers, the standby being quickly brought into use should a failure occur in one unit. An additional feature is the provision of two indicator units which are, for many purposes, entirely independent so that two pilots or pilot and navigator may have their own displays which may be arranged to suit their own particular purposes. Naturally the control of the scanner itself is only possible from one of the two display units, this one being termed the "master."

An interesting development from Decca is the Omnitrac. This is a small airborne digital computer, also transistorised, which is capable of converting the hyperbolic co-ordinate data given by the Decca Navigator to cartesian co-ordinates, permitting a direct visual plot of position upon a chart. It also provides bearing and range information upon any point within the coverage to an accuracy consistent with that of the system as a whole.

Also from Decca is a new and largely transistorised version of their doppler radar. Apart from the introduction of transistors the various units have been redesigned to conform with the ARINC standards for shape and size of units and the layout of aircraft wiring, so that it is easily installed in aircraft, particularly American, using these standards. It has one feature additional to those demanded by ARINC and this is the provision of an output suitable for driving the Decca Flight Log.

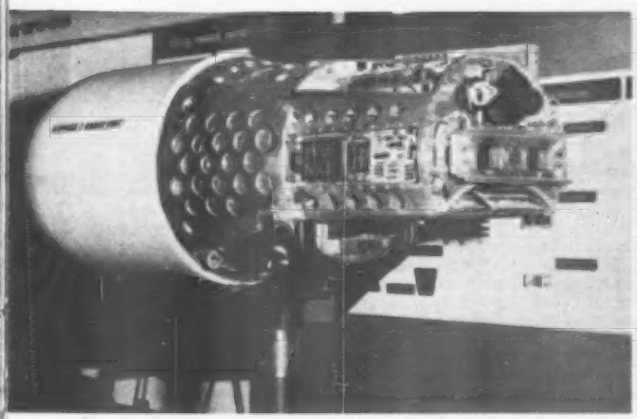
Cossor have produced a number of innovations in the manufacture of components for radar sets. These are not essentially new ideas this year but are on show as production items for the first time. These are firstly strip transmission lines, which are a form of printed waveguide and second, quartz crystal delay lines. Both of these items are now incorporated in the complete radar sets manufactured by the firm.

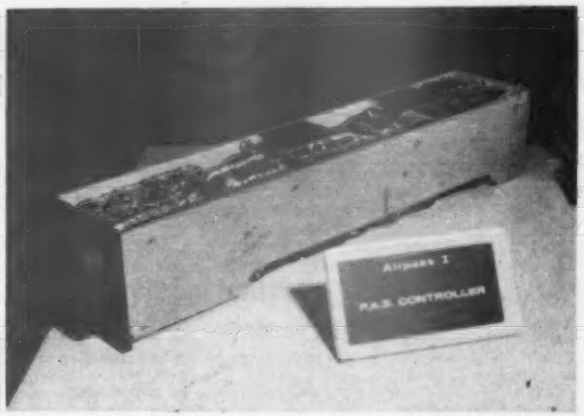
Yet another piece of equipment employing transistors is the Standard Telephone and Cables type STR40 radio altimeter. This has been developed for use with the AUTO-LAND system and is characterised by a very high accuracy, particularly at touchdown, when the error does not exceed one foot.

Autopilots

Interesting developments in autopilots are those by Honeywell and by Newmark. The Honeywell instrument is said to be "adaptive" in the sense that it is not necessary to carry out numerous trials of the aircraft fitted with the autopilot in order to set up the various controls of the instrument. The outputs of the three rate gyros are combined in a form of logic circuit which determines and sets the gains of the various loops in the system.

The Newmark autopilot is especially designed for use in helicopters and has the usual three channels plus an additional one intended as a sort of collective control.





For the first time the Ferranti Airpass radar unit is shown with its rear cover removed to reveal some interesting examples of the electronics engineer's art. Right is the Airpass controller unit.

Communication Systems

Many companies are now interesting themselves in the problems of communication between ground and air and between aircraft. There are several newcomers to the field and several new ideas. Plessey have two systems of particular novelty; one is a flight-deck communication system for use on aircraft carriers where flight-deck crews require to receive instructions from a central controller in the midst of a considerable confusion and noise. To do this an inductive loop is set up around the deck by a cable carrying an audio-frequency current. By certain coding arrangements it is possible to call up any specific member of the crew, the person called being then able to talk to control over a high-frequency radio link. This is similar in essence to the systems of pageing already in use in some hospitals.

The other Plessey system is one for use in the last-minute briefing of aircraft crews just before take-off, when radio silence may be in force. This is a straightforward line arrangement coupled to the aircraft by snatch plugs which uncouple as soon as the aircraft moves off.

Marconi have produced a new range of communications systems in their 60 series. These are essentially re-engineered versions of previous designs but are of particular interest because in their design and manufacture every effort has been made to ensure the very highest reliability. Reliability is a difficult thing to specify, to assess and to build into equipment. In the long run it seems that the best one can do is to learn by past experience and mistakes. By this means one can attempt to incorporate in new equipment all those features which appear to have given good results or which, from commonsense considerations ought to give good results.

Having done this, however, it is as often as not discovered that in the process one has inadvertently introduced some other quite unforeseen difficulty so that even after the most strenuous efforts have been made only a long term of trial under actual operating conditions can really prove a new design. The new Marconi units have apparently been designed with these facts fully in mind. To be seen is one of the transistorised modules of which the equipments are constructed. The module is enclosed in a sealed can and a collection of about six of these cans dissipate only 5 watts of power as against more than 50 in the original designs.

A new and versatile transmitter for aeronautical communications is the G420 by Redifon, capable of a power of 1.5 kilowatts and suitable for ISB and SSB working and fitted with provision for automatic and remote tuning to one of eight selected frequencies. A variety of drive circuits can be fitted.

Simulation

There are, of course, already a large number of manufacturers selling analogue computers for simulation studies upon projected aircraft designs. The latest such computer to appear is that by General Precision Systems Ltd., who are showing a 30 amplifier computer set up to solve a lateral stability problem. This computer, contains a number of facilities for the solution of non-linear equations and a comprehensive control and display facility. One such system is to be used by English Electric for studies on the Mk 3 Lightning.

Another simulator, which in fact represents a trend not too apparent at the exhibition but nevertheless real, is the one by Redifon, intended for the training of air traffic controllers. A number of consoles may be linked to a single display unit of standard format. Each console simulates the signals corresponding to the entry of two aircraft into the field of surveillance of the controller. The simulated aircraft may be put into orbit around the landing field or entered into the display suddenly and its height, position, bearing and speed are readily controlled. The trainee controller is in the usual R/T communication with the various aircraft and can give instructions to them.

Air traffic control itself is not too well represented, although Ferranti are at present carrying out trials on a system employing one of their digital computers.

Data Handling

One quite important development during the last year or so has been the increase in the use of automatic equipment for the handling of data, particularly in the digital form. The tendency has been for the aircraft companies themselves to embark upon the design and construction of suitable equipment, which they later market outside. The reasons for this may be seen in the uses to which such equipment is put, one of the principal ones being the collection, reduction and assessment of data obtained from flight, structural, engine and wind-tunnel tests.

The gear with which such data handling equipment has to be used tends therefore to be rather individualistic and it has not been easy to find commercial manufacturers able to supply sufficiently versatile equipment to meet the many needs of the various users. The result is that concerns like Armstrong Whitworth, Blackburn, English Electric and Bristol Aircraft have been obliged to enter the field.

An associated item of interest is the G.E.C. Inductosyn, which is just one of many such devices for the reading of aircraft parameters during flight for transmission to the ground in digital form or for direct recording in the aircraft itself.

An aspect of data-handling which is likely to be of considerable interest as the traffic in the air increases is that of seat-reservations. At present only Ferranti appear to be actively engaged in developing suitable systems capable of providing quick information to a number of booking agencies of seat availability, cancellations, etc.

In this necessarily brief preliminary survey of the electronic exhibits at this year's show, it has not been possible to mention many items of intrinsic interest. Nevertheless, it is hoped that sufficient has been said to have given some indication of the general trends.—G.H.S.

Broadband telemetry equipment for guided missiles application is one of the features of the M.o.A. stand.

Report from Farnborough . . .

Missile and Aerospace Exhibits

PROSPECTS of Britain joining the United States and Russia in launching artificial satellites lend special interest to the work of R.A.E., Farnborough, with the two-stage Saunders-Roe Black Knight. Following cancellation of the Blue Streak LRBM, the re-entry experiments being performed with this vehicle at Woomera have been regarded essentially in the light of work which may lead to the recovery of equipment from orbit.

On the Ministry of Aviation stand in the main static exhibition is a full-scale sectioned model of the solid-propellent, second-stage which is carried nozzle-forward on the nose of Black Knight. This second stage has been developed by the Rocket Propulsion Establishment at Westcott.

When launched the first stage completes its thrust and the separated second stage then coasts on up to the zenith of its trajectory, reaching a height of about 370 miles before dropping back towards the Earth. The top stage is separated and spin-stabilised by gas-jets angled at 45° and offset in a fairing above the nozzle for the purpose of maintaining a vertical flight attitude after separation. When the stage has fallen to a height of about 70 miles, the air-jet stabiliser package is discarded and the rocket motor fires. Ignition is marked by a pyrotechnic flash at 60 miles altitude.

Just after the rocket re-enters the atmosphere, at a height of some 40 miles, the nose-cone is released from the second stage assembly and goes on to strike the ground in the target area some 60 miles from the launching point. The first and second stages disintegrate as they re-enter the atmosphere.

Although re-entered without any decelerating drogue-device, the nose-cone carries an R.A.E.-developed magnetic tape recorder. Protection of the recording tape against fire and impact damage is afforded by a heavily armoured cassette.

Stabilised Space-Telescope

Another item of space-research interest—although not in the "hardware" sense—was available from Elliott Brothers (London), Ltd., a member of the Elliott Automation Group, who announced last Saturday that they are working on a "British space research project" in conjunction with the R.A.E.

It turns out that this is a design study into a stabilised platform for a small satellite telescope. Basis of the work is the R.A.E. investigation into the adaptation of Blue Streak and Black Knight for satellite launching involving a new third stage rocket, as described by Mr. E. C. Cornford in THE AEROPLANE AND ASTRONAUTICS, August 12, 1960. Payload available for the astronomical satellite was given as 1,750 lb., with an orbital height of 300 n. miles.

Another item of interest is that Pye, Ltd., and McMichael Radio, Ltd., have been able to reveal something of their work in providing miniaturized electronic equipment for the first Anglo-American Scout satellite scheduled for launching late next year.

Blue Steel

Pride of place among the exhibits in the Guided Weapons Park is undoubtedly taken by Avro Blue Steel stand-off bomb which is on public view for the first time. The weapon will enhance the striking power of Victor and Vulcan V-bombers of R.A.F. Bomber Command until beyond the mid-1960's, when its use is expected to be supplemented by the Douglas Skybolt ALBM.

Unlike the ballistic Skybolt, Blue Steel has a canard aircraft configuration with delta-shaped foreplanes for pitch control, a rear-mounted delta-wing with tip anhedral and inboard ailerons, and a pair of vertical stabilisers. The lower stabiliser folds sideways to provide ground clearance when this bomb is carried under the aircraft.

Powered by a Bristol Siddeley Stentor twin-chamber rocket engine of unspecified thrust, the weapon comes under the command of its inertial navigation system from the moment it leaves the parent aircraft and does not rely on external control signals of any kind. Its guidance system is, therefore, immune to jamming by enemy countermeasures.

Anti-aircraft Defence

Although familiar exhibits at Farnborough, the surface-to-air missiles Bloodhound and Thunderbird always provide some extra item of interest. Last year, we were able to examine a cut-away version of the Bristol/Ferranti Bloodhound and a Bristol Siddeley Thor ramjet similarly "opened up."

On this occasion, Bristol Aircraft, Ltd., have been able to include—in addition to a sectioned Bloodhound—some details of their progress with a "second-generation" variant of this missile. They confirm, as we have long suspected, that the Mk. II version will employ constant-wave (C.W.) homing guidance, and an electronics package is shown which incorporates advanced circuitry techniques, such as printed wiring and transistors. Performance information is classified but clear advantages in range, height and speed are expected over the Mk. I version by virtue of lighter weight and higher specific thrust.

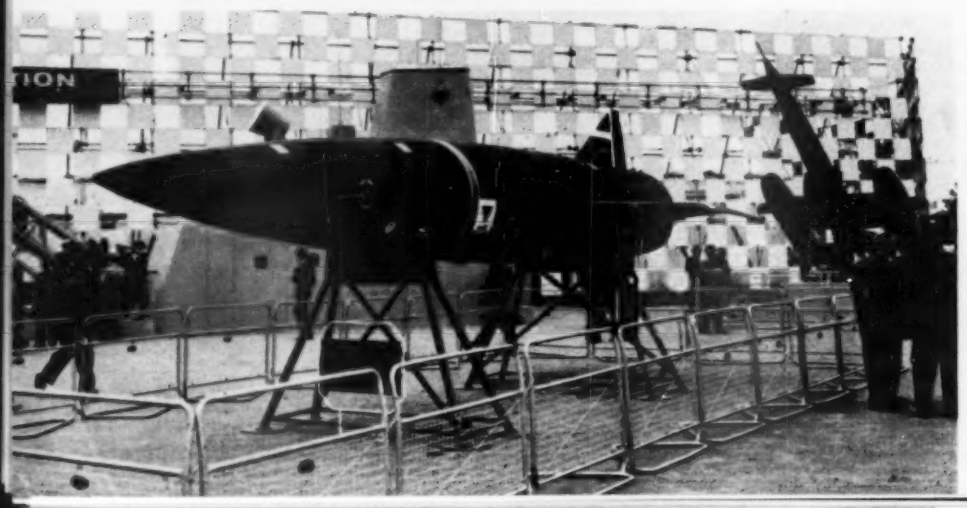
Although sectioned for detailed inspection on the English Electric stand in the Exhibition Hall, Thunderbird is at its most dramatic in the special Army demonstrations given outside. A large enclosure, next to the static aircraft park, shows the equipment to be found on a firing site. This includes four complete launchers and missiles, launcher control post, generators, tactical control radar, battery command post, and target illuminating radar.

A second demonstration within the Guided Weapons Park shows how Thunderbirds are tested and assembled ready for the firing site. Throughout the week, men of 60 Guided Weapon Battery of 36 Guided Weapon Regiment, Royal Artillery, have been demonstrating how wings, fins and boosters are fitted to the missile in a tented enclosure and, after testing, how the complete missile is run out on rails and hoisted up by crane from the handling trolley.

Another interesting display-exhibit takes the form of a 60ft. wooden mock-up, representing part of one of the Royal Navy's new guided weapons ships. The "ship" is manned by Naval personnel and has a full-scale A.W.A. Seaslug in a twin-barrel launcher on the rear deck. Inside the "superstructure" are a number of supplementary exhibits, including a Seaslug which has been cut-away to show various internal features. Nearby, a complete Seaslug tail-fin assembly can be manipulated by means of a control column to simulate the various fin movements.

Blue Water

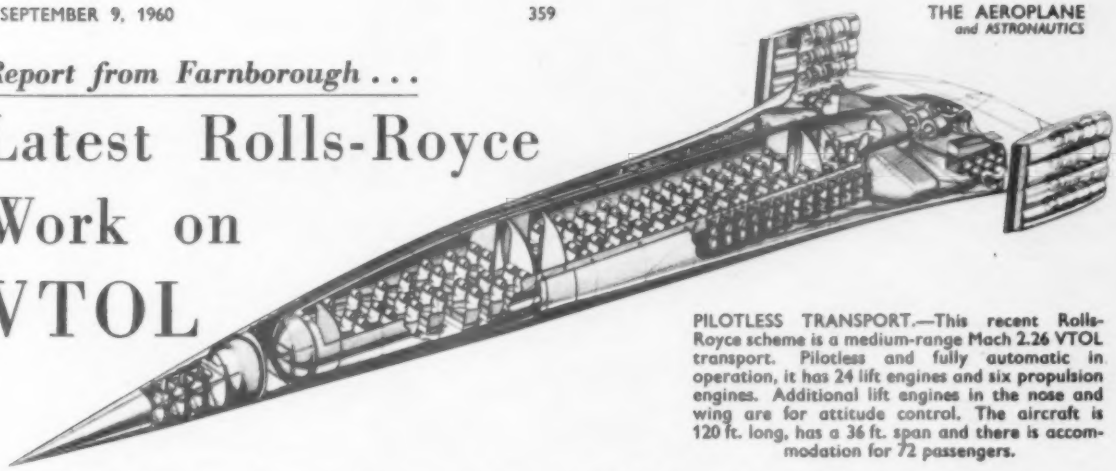
Although a model of the English Electric Blue Water was not permitted at Farnborough, a drawing of this new Corps support weapon is displayed on the maker's stand and some details are available. Propulsion is by solid-propellent without external boosters and control is by cruciform moving wings in conjunction with cruciform fixed tail-fins indexed at 45° to the former. Dimensions are: Length, approx. 25 ft.; body dia., 24 in.; wing span, 81 in.; and fin span, 77 in. Inertially guided.



Seen for the first time at Farnborough, the Avro Blue Steel stand-off bomb. At right is the Nord CT.41 supersonic twin-ramjet target which will be serviced, maintained and probably built in Britain under licence by Armstrong Whitworth Aircraft, Ltd.

Report from Farnborough . . .

Latest Rolls-Royce Work on VTOL



PILOTLESS TRANSPORT.—This recent Rolls-Royce scheme is a medium-range Mach 2.26 VTOL transport. Pilotless and fully automatic in operation, it has 24 lift engines and six propulsion engines. Additional lift engines in the nose and wing are for attitude control. The aircraft is 120 ft. long, has a 36 ft. span and there is accommodation for 72 passengers.

ALTHOUGH the supersonic VTOL airliner proposed by Dr. A. A. Griffith has received little support from aircraft designers, Rolls-Royce is still devoting a considerable effort to the development of jet-lift engines and VTOL techniques, as its S.B.A.C. Show stand indicates. The company has a deep faith in the VTOL concept, and is now developing a jet-lift engine with a thrust 16 times its own weight. It is also working to overcome problems associated with jet lift and is collaborating with aircraft companies which have active VTOL projects for military aircraft; regrettably, most of these companies are outside Britain.

Rolls-Royce studies of jet-lift VTOL go back to 1941 when Dr. Griffith suggested that the high thrust/weight ratio of turbojets should allow an aircraft to make a "jump take-off" if jet deflection were used. In 1945, Dr. Griffith proposed an unmanned "tail-sitter" interceptor.

After further work, he concluded in 1952 that the vertical thrust needed for take-off could best be provided by specially designed lift engines. In this way there need be no compromise caused by the big difference between the requirements of lift and propulsion. The use of independent lift engines has up until now been considered essential by Rolls-Royce unless very short-range VTOL aircraft are required.

In 1953 Rolls-Royce flew the "Flying Bedstead" to demonstrate the feasibility of jet-lift VTOL and to develop a control and stabilisation system. The next stage was the Short SC.1, powered by five specially developed RB.108 engines, which is demonstrating VTOL flight at Farnborough this week.

Rolls-Royce feel that the next stage is for Britain to produce an operational VTOL aircraft using separate lift and propulsion engines. This technique has great potentialities for a new civil transport system, but its introduction in military aircraft seems likely to come first and would prepare the way for civil applications.

Civil Projects

British designers of supersonic airliners "have used all Dr. Griffith's ideas except vertical take-off"—to quote a Rolls-Royce executive. Although rather sweeping, this view is justified so far as basic configuration is concerned. The need for high cruising altitudes (and thus low wing loadings) has combined with aerodynamic advances so that Mach-2.2 slim-delta airliners can now be designed which have an adequate low-speed performance and can thus operate from runways. But Rolls-Royce feel that the lower aspect ratios necessary for cruising speeds around Mach 3 cannot be reconciled with conventional take-offs and landings, and that VTOL will be the answer for "second-generation" Mach-3 airliners.

For this reason, a short- or medium-range system of VTOL travel at subsonic speed may come into being first. It would rely on installations of its own, separate from those of existing airports. The flight would be almost totally under automatic control, direct to the destination, and the normal taxying and stand-off delays would be eliminated. Techniques for automatic take-off and approach, transition and landing have been evolved by Shorts and Rolls-Royce.

Essential features of this transport system are that services should be regular and frequent, with no need for advance booking. Aircraft would take-off and land from sprung gridded pads, eliminating the need for an undercarriage, and exhaust ducts would cope with the jet efflux.

In studies of such systems Rolls-Royce originally estimated that the lift engines would run for 3 min. per flight. Experience now suggests that this is much too conservative; the SC.1, for example, reaches transition speed 18 sec. after lift-off and converts back to hovering flight in 25 sec.

Noise is the great problem and this has led Rolls-Royce to consider fan variants of lift engines. Although these have a much higher thrust than the basic turbojet, their specific weight tends to be less favourable and the installation creates problems.

Rolls-Royce considers that the simple jet-lift engine is the best solution for high-performance aircraft where low installed bulk and drag is important. But for moderate-speed aircraft of the inter-city transport or military assault type, fan lift could be superior. Grouping of lift engines helps reduce the noise level and the development of silencers for them is simpler than for propulsion engines, because the effect of the silencer on s.f.c. is not very important.

Military Studies

It is basic Rolls-Royce policy that the company produces engines, and not aircraft. But aircraft design studies must be made to decide the type of engine which will be needed in future. This has been particularly necessary for its VTOL work.

One study has compared the requirements for VTOL and STOL aircraft (STOL in this case being defined as the ability to reach a height of 50 ft. in a distance of 500 ft.). It shows that the thrust requirement is so high for the STOL aircraft that it would be more economical to design a VTOL aircraft from the start. With the very light lift engines now possible, sufficient jet lift could be installed to give a considerable overload performance.

Take-off techniques have also been studied; if a very short ground run is used, with lift engines opened up a second or so after propulsion engines, the problems of recirculation and ground erosion are avoided. Practical tests on these lines are being made with an RB.108 mounted vertically in a Meteor.

Another study has been made of a light strike aircraft intended to operate at sea level, cruising above Mach 0.85. Two approaches were compared. In the first a single engine was used for both propulsion and lift, using jet deflection; in the second, light lift engines were allied to an efficient propulsion engine. In the first case the all-up weight was more than 35,000 lb.; in the second under 20,000 lb. The conclusion is that for a radius of action above some 150 miles the superior fuel consumption of an efficient propulsion engine pays off when compared with combined propulsion and lift engine, which has a poor s.f.c. because it must be heavily throttled during the cruise.

Rolls-Royce is devoting considerable effort to the development of light jet-lift engines and to studies of such VTOL problems as safety, control, noise and ground erosion.

As already mentioned, the company is now developing an engine which will give 16 lb. of lift thrust for each lb. of its weight. New materials will probably be used for this engine. Rolls-Royce and other companies have considerable experience with plastic compressor blades and casings; a jet-lift engine would be a logical application for these. As well as saving weight, they could help reduce the cost considerably. In fact, the latest Rolls-Royce jet-lift engine is expected to cost less than half as much as a comparable engine of conventional construction.

Other ways of reducing cost and improving specific weight are by simplicity of layout, high component efficiencies, and compact combustion systems. All these have probably been used.

Thorough system studies have been made to reduce the installed weight of lift engines. On the SC.1 the ratio of installed engine weight to bare engine weight is 1.7:1. This ratio could be maintained with new engines having half the weight of those in the SC.1; in other words, system weight has been halved as well as engine weight.

If present trends continue, it is more than likely that European aircraft companies will produce supersonic VTOL strike aircraft with Rolls-Royce lift engines before British companies do so. Rolls-Royce appears to be playing the rôle of the prophet without honour in his own land. It will indeed be unfortunate if other countries reap the benefit from the pioneer VTOL work of the Short and Rolls-Royce teams.—J. R. C.

Above: Armstrong Whitworth's Argosy (Rolls-Royce Darts) exemplifies the new generation of utilitarian turboprop transports. *Right:* A pair of the Royal Navy's latest strike aircraft, the Blackburn Buccaneer (de Havilland Gyron Junior).

Below: This year's newcomer, the Avro 748 feeder-line transport (Rolls-Royce Darts) making its first display appearance.

ABOVE

Report from Farnborough . . .

THE CLOUDS AT FARNBOROUGH

Photographs copyright "The Aeroplane and Astronautics"

Above: The two-seat Gnat Trainer (Bristol Siddeley Orpheus) shows off its diminutive lines to advantage.

Left: Even when sporting outsize wing fuel tanks, the Hunter two-seater (Rolls-Royce Avon) remains a most elegant aeroplane.

VULCAN SCRAMBLE

Photographs copyright "The Aeroplane and Astronautics"

Report from Farnborough . . .

Left: The C.O. of No. 617 Squadron, Wg. Cdr. L. G. A. Bastard, A.F.C. (left) talking to Air Vice-Marshal J. G. Davis, C.B., O.B.E., the Air Officer Commanding, No. 1 Group, Bomber Command, and Gp. Capt. H. Burton, D.S.O., M.B.E., the Station Commander of R.A.F. Scampton, during work-up training for the Farnborough show.

Above: Four Avro Vulcan B.1s of No. 617 Squadron in position on the end of the runway at Scampton for a rehearsal "scramble". In addition to this Bomber Command squadron, No. 148 operating Valiants from R.A.F. Marham, and No. 15 with Victors at R.A.F. Cottesmore, are providing four V-bombers each on different days at Farnborough.

Below: A No. 617 Squadron Vulcan getting airborne within three minutes of the crew, at cockpit readiness, receiving a "scramble-scramble-scramble" order from Headquarters, Bomber Command. *Right:* A crew chief operating a ground power unit prior to a practice scramble.

Report from Farnborough . . .

Lightnings into Service

English Electric Lightning supersonic fighters—powered by Rolls-Royce Avon turbojets—are now in Squadron Service with Fighter Command of the Royal Air Force. The first R.A.F. Lightning squadron is No. 74 which is based at Coltishall.

Above: A pair of Lightning F.1s of No. 74 Squadron (Sqn. Ldr. J. F. G. Howe) from R.A.F. Coltishall. Before conversion the Squadron was equipped with Hawker Hunter F.6s.

Left: A Lightning from the English Electric pre-production batch of 20 taking off from Coltishall during Service trials with the Air Fighting Development Squadron of the Central Fighter Establishment. *Right:* Sqn. Ldr. R. R. Harding, an A.F.D.S. pilot who did much of the Service testing of the aircraft, wears a pressure jerkin and holding a partial pressure helmet.

From Wing-borne to Hovering Flight

Tom Brooke-Smith, the pilot of the Short VTOL SC.1, gives an exclusive account of flying this unique British flat-riser

AFTER some four years' exploratory and development flight-test work with the SC.1, the three phases of flight—conventional, stationary and transient—were linked together at Bedford on Apl. 6 this year, when the first complete transition from wing-borne to hovering flight and back again was made. Since then the sight of this aeroplane flying about without so much as turning a wheel on any of Bedford's magnificent runways—and literally dropping in to perch on the apron outside its hangar door at the culmination of a day's activities—has become commonplace.

Here now is an aeroplane a pilot may fly at 200 kts.-300 kts. supported and controlled by the aerodynamics of its wings and surfaces or, should he wish, in stationary, vertical, sideways, forwards or even backward flight, supported and controlled by high-velocity jets. He is able to pass from jet-borne to wing-borne flight in a safe and extremely simple manner or, likewise, hold any transient condition between these two flight regimes. This all sounds very simple. And from the actual flight handling point of view this, indeed, is how it is.

But it should not be forgotten that the SC.1 is an experimental aircraft. Its sole object in life is to discover and to develop the hardware required to give an aircraft not just VTOL capability—but VTOL capability with safety and with reliability. It follows that some of the mechanisms necessary to this exercise at certain stages will come to be disregarded at others, and for this same reason the pilot's cockpit may appear at first sight to be somewhat cluttered with instrumentation, switches and levers, and the pilot's drills somewhat extensive, were it not appreciated that all—or, at least, nearly all—of this clutter has a test evaluation purpose and will in due course be eliminated. Likewise, as development proceeds, essential drills will be reduced to bring all cockpit work into harmony with the A.B.C. simplicity of the aircraft's VTOL flight handling characteristics.

From an engineering point of view, the SC.1 has already been introduced (THE AEROPLANE AND ASTRONAUTICS, Jne. 10, 1960). From the pilot's standpoint, however, one or two of the more essential details are worth a recap before passing on to describe the transitionary flight characteristics of this unique aeroplane.

Control of attitude is at all times by means of the conventional column-type stick control. In wing-borne flight it is effected by means of the normal aerodynamic surfaces, viz., elevators, ailerons and rudder. Apart from the elevator, which has a power jack, these are manually operated. In addition, if desired, the elevators and ailerons may be operated through the auto-stabilizer servos either with or without stabilization. Under such circumstances control from the stick would then be by electric signal as distinct from levers and rods. The rudder is at all times manually operated by means of a conventional rudder bar.

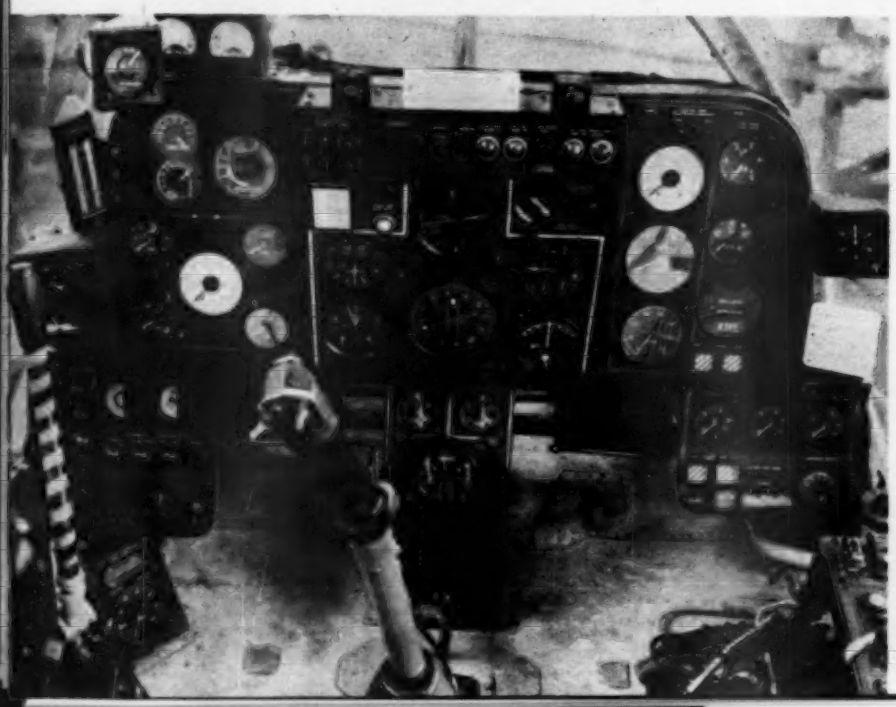
In jet-borne flight, control is by means of high-velocity air-jets. These jet controls or nozzles are four in number. They are located at the nose and tail to provide control in pitch, and under each wing-tip to provide control in roll. Asymmetric operation of the jet nozzles by a simple mechanical linkage to the rudder-bar provides control in yaw. Air for this jet control system is tapped from the compressors of the four vertically mounted lift engines. The pitch and roll jet nozzles are operated by the auto-stabilizers which hold the aeroplane level about these two axes, the pilot controlling attitude by stick signals which merely shift the datum of the platform.

Two degrees of stabilization are available to the pilot, viz.: RATE-AUTO and FULL-AUTO. RATE-AUTO provides the characteristic aircraft control to which a pilot is normally accustomed together with a degree of damping. FULL-AUTO introduces a displacement term providing a stiffer control with a positional or displacement characteristic. Of these, the pilot may select whichever he likes or change from one to the other whilst airborne. The writer has so far mainly used the RATE-AUTO condition—the looser and more natural of the two; further work may show that FULL-AUTO is necessary for instrument approaches.

Vertical flight control is by means of the four downwards pointing lift engines (Rolls-Royce RB.108) mounted in the belly of the aeroplane. They are collectively throttled by a single lever similar to the collective pitch control of the helicopter. When this control is raised or lifted, the thrust of the four engines is increased and vice-versa. This control lever is referred to as the LIFT CONTROL. It is a balanced lever and since the SC.1 is relatively free from vibration, it will stay in any desired position, thus freeing the pilot's left hand should he wish to use it for any other reason whilst in vertical flight.

Forward flight control is by means of the rearward pointing propulsion engine (Rolls-Royce RB.108). This is operated by a normal console mounted throttle (conventional flight) and by a twist-grip mounted at the end of the lift control (transitionary flight), thus bringing control of all five engines to the one hand when required. Forward flight is also achieved by tilting the lift engines in the accelerate sense, engine tilt operation being selected by a small stick mounted switch similar to the fore and aft trimmer switch on some aircraft. Forward pressure on this switch moves the engines in the accelerate sense—backwards pressure moving them in the decelerate sense.

Rearwards flight is achieved by tilting the lift engines in the decelerate sense. Forwards or rearwards motion may, however, be produced without the use of the propulsion engine or of the lift engine simply by increasing or decreasing the attitude of the aircraft in pitch. Likewise, sideways motion may be generated by holding on bank in the direction in which it is desired to travel.



Inside the cockpit of the SC.1 some unusual instruments are visible. On the left can be seen an A.S.I. calibrated to give m.p.h. backwards as well as forwards.

Report from Farnborough . . .

Cockpit Drill

Upon entering the aeroplane, the pilot settles into his Martin-Baker ejector seat. This has zero-zero capability, which means that it is a life-saver even when the aeroplane is motionless on the ground. The flight instruments are switched on and auto-stabilizers switched to NON-AUTO to spin up the gyros and, generally speaking, warm up the boxes. Warning lights, magnetic indicators and audio-warning systems are tested and the general pre-start checks cleared. The generators, inverters, booster pumps, etc., all located on the starboard console, are switched on and, from then onwards, this particular panel can be forgotten. The pilot now transfers his attention to the engine starting panel at his left hand and selects STARTING AIR to the propulsion engine.

Above: Tom Brooke-Smith at the controls of the dynamic simulator which was also used for the functional testing of the hydraulic auto-stabilizer, air nozzles and other systems. *Below, left:* The auto-stabilizer controls of the SC.1. *Below, right:* Throttle controls and auto-stabilizer selectors. The lift control with propulsion twist grip is conspicuous.

When the engine speed indicator reaches the required r.p.m., he selects ignition and moves the H.P. cock to the ON position. Light-up will take place immediately. STARTING AIR is switched off as soon as the correct idling condition has been attained, and the engine is then opened up to check operation of the compressor bleed, after which it is again brought back to idling.

The control selector mechanism is now set as follows:—SURFACES TO MANUAL . . . JET NOZZLES TO STABILIZED. The appropriate indication is double checked. The auto-stabilizer is switched to RATE-AUTO on both axes and this selection is also double checked. A check of control travel is made by displacing the stick fully in pitch and roll . . . at the same time, the dash mounted nozzle indicators are observed and the stabilizer fault warning indicator checked CLEAR.

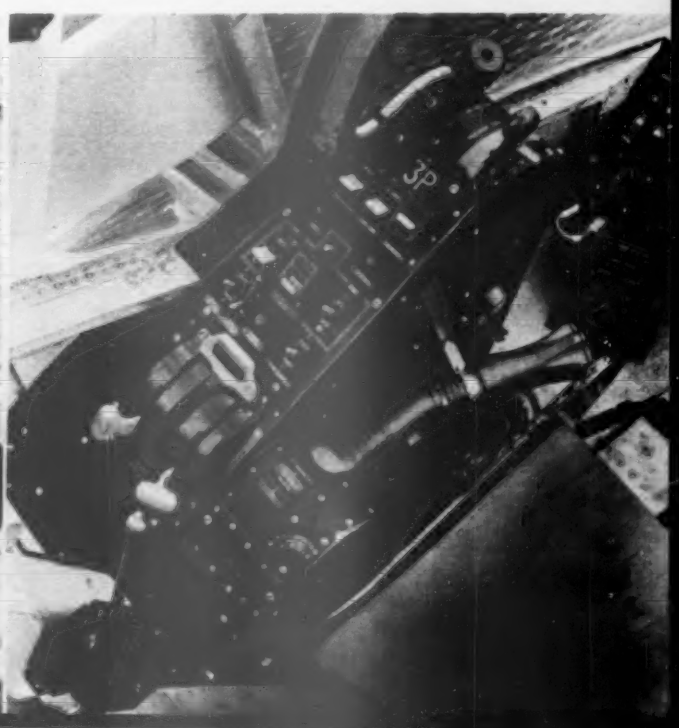
All is now ready to flash up the lift engines. The air-intake gills are opened and the fact that they have opened is checked on the cockpit indicator (the gills are behind the pilot and cannot be seen by him). The propulsion engine is opened up to approaching max. JPT and air is then tapped from its compressor to spin up the lift engines to their required light-up speed when ignition is selected and the four H.P. cocks situated on the bulkhead at the pilot's left elbow thrown to the DOWN spring-loaded ON position. Light-up is immediate and simultaneous. The four JPTS are checked as the engines are brought to their idling condition and the compressor bleeds closed. The STARTING AIR selector is switched to the OFF position and the propulsion engine throttled back.

The pilot now once again checks his controls against the dash mounted indicators, checks his warning system and obtains permission to LIFT on the R/T. He signals, "Chocks Away," unparks his wheel brakes and is ready to go.

He raises his lift control smoothly and progressively and literally "picks" the aeroplane from the ground, allowing it to rise to some 50 ft. or so. Here he eases this control off a little and checks his ascent. He is floating on air and he will be amazed at the response of his four vertical Rolls-Royce RB.108 engines and the precision with which they enable him to control his height.

The aircraft is quite stable and no continuous stick motion (pudding stirring) is required to hold it in stationary flight directly above its point of take-off. The controls are beautifully light and free from inertia. Response in pitch, roll and yaw is excellent, but there is no tendency to over-control. When the column is eased back, aircraft attitude is increased and the aeroplane starts to fly backwards. A forward stick movement reduces this attitude and arrests the backward motion. In a similar manner the aircraft moves sideways when bank is applied. This is all very pleasant, and has the right sort of feel about it.

A slight pause in hovering flight after the vertical take-off allows the pilot to adjust his trim on the stick mounted switch in the direction he wishes to go, i.e., forward. Any slight loss in vertical component is compensated for on his lift control and as the aeroplane surges forward, he opens up the propulsion engine by rotating the twist-grip in his left hand. As speed builds up, the aircraft becomes slightly tail heavy, and is trimmed a little nose down to compensate. Apart from the fact that the SC.1 becomes slightly more responsive or lively in pitch and yaw as the aerodynamics build up (above about 75 kts.)—the transition from stationary to wing-borne flight is otherwise quite



Close-up of nose air nozzle installation showing shutter and method of operation.

smooth and free from any short-comings in control or stability. It is accomplished in something under 20 seconds.

At 160 kts. the pilot switches his auto-stabilizer to NON-AUTO. He then reduces his lift engine r.p.m. to the idling condition and trims the aircraft slightly nose up (there is a nose-up change of trim when the lift engines are brought on the line and therefore a corresponding nose-down change of trim when they are dispensed with). The four lift engines H.P. cocks are slammed to the off position—a momentary feeling of loss of power is noticed but a check of the A.S.I. shows plenty of speed in hand. The gills are closed and the SC.1 is now operating as a conventional aeroplane.

In order to bring the aircraft from wing-borne flight and to a vertical landing, the lift engines are first brought back on to the line. This is done as follows: The lift engines are checked at the max. accelerate tilt position. The propulsion engine r.p.m. are increased to the desired speed and JPT. The lift engine intake gills are opened—and the fact that they have opened is checked on the cockpit indicator. Air is bled from the propulsion engine compressor and switched to the four lift engines. Ignition ON is selected when they have attained their desired light-up speed (about two seconds). All four lift engines light up instantly and simultaneously when the H.P. cocks are thrown to the DOWN spring-loaded ON position and are accelerated to the flight idle condition; the pilot will notice a moderate nose-up change in longitudinal trim and he will zero this, using his stick mounted trimmer switch.

The lift engine starting air is turned OFF and the auto-stabilizers now switched to RATE-AUTO. The stick is displaced fully in pitch and roll against the nozzle indicators and the stabilizer fault detection system checked CLEAR.

The cockpit drill is carried out at about 1,000 ft. or as convenient—on the reciprocal flight path to the desired final approach direction. (This would normally be referred to as the DOWNWIND LEG—an expression deliberately avoided here since wind direction does not restrict this aircraft during VTOL as it does the fixed wing aeroplane.)

Height is reduced during the final turn-in—at 160 kts.—towards the landing point and adjusted as local topography may permit. The lift engines are momentarily opened up and their max. r.p.m. and JPTS briefly checked. Speed is reduced to 140 kts. on the straight final approach and at some 2,500 yd. from the landing point the propulsion engine is throttled down to its idling condition. As speed reduces, height is maintained initially by a slight increase in aircraft attitude, thence by increasing lift engine thrust as required.

The pilot now has some 2,000 yd. in front of him and 500 ft. below, the point upon which he wishes to place his aeroplane. He progressively reduces his lift engine tilt and as he does so the aircraft decelerates fairly rapidly. As speed falls off, and the wing does less and less work in terms of lift, so the pilot increases the thrust of his downward-pointing engines by raising his LIFT CONTROL.

This progressive transfer to jet-lift comes perfectly naturally to the pilot and no special angle of attack indication or other instrumentation is required. He flies the aeroplane in on a sinking deceleration approach, finally zeroing his engine tilt and bringing it into stationary jet-borne flight vertically above his landing point. He now simply lowers his aircraft under perfect control on to the ground. This is exceedingly simple and requires nothing more of the pilot than the sort of perception required of a child in climbing down a ladder.

In conventional wing-borne flight, the SC.1 is brought in on the final approach at 140 kts. Like all aircraft with more than moderate sweep, the approach attitude is high and the large rolling moments with yaw and slip make it unpleasant to handle in cross-wind conditions. With parachute and with optimum use of the wheel brakes a good 1,800 yd. of runway is used in the landing and more than average skill and concentration is required in this operation—the pilot having to "drive" the aeroplane on to the ground all the way.

The vertical landing is, however, quite another story. The pilot has more time to think and less judgment to exercise. His landing sequence is much simplified. He may now vary his rate of approach and his vertical flight path each independently of the other. Considerably less skill and concentration is required—the aircraft may even be trimmed to fly "hands off" in the transient regime. Cross-winds do not matter now any more. Instead of burning-up 1,800 yd. of runway, the aircraft can be dropped down beside the hangar door without a wheel turning.

Sir Matthew Slattery, former chairman of Shorts, has described the SC.1 system for VTOL as a major break-through in aeronautical progress.

To those who fly the aeroplane, the veracity of this statement will be brought home with some force.

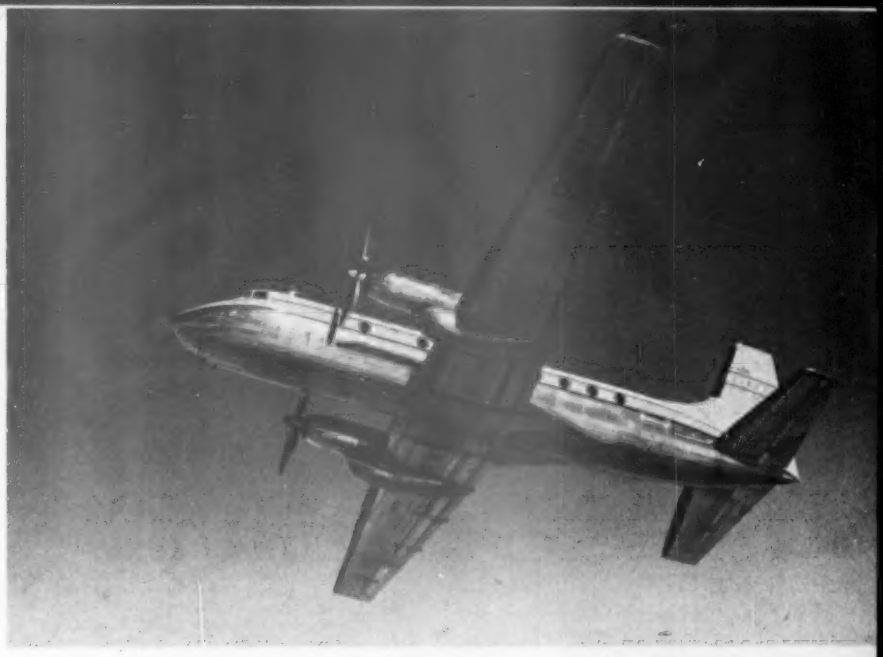
. . . the writing is on the wall.

The author of this article with the Short working party at R.A.E. Bedford, where the first transitional flight was made.

Report from Farnborough . . . .

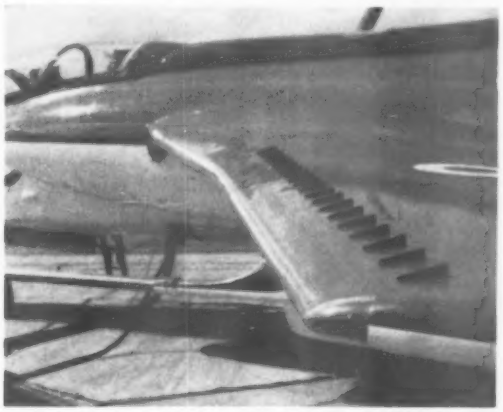
Aircraft on Show

Full-scale and Model Exhibits



FARNBOROUGH DEBUT.—The Avro 748 prototype in Skyways light blue and white, which has done more than 60 hours flying since Jne. 24.

Armstrong Whitworth A.W.650 Argosy (Four R.-R. Dart 526). Since the prototype's first flight on Jan. 8, 1959, six Argosies have flown over 2,000 hr. Demonstrated at Farnborough is the fourth, G-APRN, together with double-end loading using the Rolamat system and carrying a Thunderbird missile and netted stores on pallets and loading ramps. The second Argosy, G-APRL, fitted with military A.W. 660 "crocodile jaw" rear loading doors, was expected in the flying display only, and a model of the A.W. 660 is shown with representative loads in the exhibition tent.



B.L.C. on the Blackburn Buccaneer. On this later version the blowing slit is nearer the nose.

Auster D.4/108 (One Lycoming O-235-C). Smallest (two-seat) member of the new Auster D range; CS-AMA is in the static park, with cowling locked to hide its U.S. engine. The first production D.4 flew on Feb. 12, 1960, and deliveries have begun. The example shown is one of a large production contract for Portugal.

Auster D.6/180 (One Lycoming O-360). Also statically displayed, G-ARDJ is an example of the most powerful four-seat D.6 variant. The first flight of this four-seat type, with a 160 b.h.p. engine, was made on May 9, 1960. The D.6 is derived from the Autocar, with a 2-in.-wider fuselage, 36-ft. span wings, a superlative interior and exterior finish, a revised instrument panel, strut-end fairings, wheel spats and a faired tailwheel leg. A McCauley constant-speed airscrew is fitted.

Auster 6A (One D.H. Gipsy Major). This is a recently developed commercial version of the ex-Army Auster A.O.P. 6, now available from Auster's for £995 with C. of A. A two/three-seater, the Auster 6 is suitable mainly for glider-towing, and two examples, G-ARCY and G-ARDX, are so used during the displays by Slingsby and Elliott sailplanes on Friday, Saturday and Sunday.

Avro 771 (Two B.S. 75 turbojets). A model in the exhibition tent shows the general appearance of this short-haul jet transport project (see page 380).

Avro 748 (Two R.-R. Dart 514). The prototype Series 1, G-APZV, making its first Farnborough appearance. Finished in Skyways light blue and white colour scheme; unfurnished interior with test instrumentation and water tanks for varying C.G. More than 60 hr. airborne since first flight on Jne. 24. Indoor exhibition includes a 1/10th scale model and a full-size fuselage section, in Aden Airways colours, including flight deck and part of cabin.

Avro 698 Vulcan B.2 (Four B.S. Olympus 201). The second production example, XH534, in the latest anti-radiation finish with pale blue for serial number and national markings, and the extended rear fuselage for ECM and flight refuelling probe in nose. First squadron delivery of a B.2 was made on Jly. 1 this year; the first production B.2 flew in August, 1958. In the exhibition tent, a large Vulcan 2 model is seen with the Blue Steel stand-off bomb. On Tuesday and Saturday, four Vulcan B.1s (Olympus 104) from No. 617 Squadron provide the R.A.F. "scramble" demonstration.

Avro 696 Shackleton M.R.3 (Four R.-R. Griffon 57). Provided by No. 201 Squadron, a Shackleton is seen arriving each day at the end of a 22-hour patrol, and takes off later in the flying programme at the start of another similar mission.

Avro 694 Lincoln 2 (Four R-R. Merlin 68). Second Farnborough appearance of G-29-1, the Napier icing research aircraft. Mounted vertically on the fuselage is a Blackburn Buccaneer wing section, and a Blackburn Palouste in a ventral fairing provides a source of hot air for anti-icing and compressed air to vaporize water for the spray system. Other sections tested include the Caravelle wing and tail, Beverley, Britannia and Avro 748 wing and Argosy tail.

Blackburn B.103 Buccaneer (Two D.H. Gyron Junior 101). The third and fourth aircraft from the pre-production batch, XK488 and XK489, are demonstrated in the flying display. New features seen this year are the rotary weapons door and retractable flight refuelling probe in the upper fuselage decking forward of the cockpit. Small differences were visible between the two:—XK489, the later aircraft, has the leading-edge blowing slit repositioned (1¼ in. instead of 5 in. back

One of the two Auster 6As on show with glider towing gear.

Aircraft and Models at the Show

from the leading-edge); a retractable tail bumper; Doppler aerial; and doors to enclose the arrester hook. Both Buccaneers have blown wings, tailplane leading-edges, flaps and drooping ailerons. On the British Aircraft Corporation stand is a cross-section of the Buccaneer wing showing its machined skins; another section appears on Napier's Lincoln for Spraymat de-icing tests.

Bristol 188 (Two D.H. Gyron Junior). A one-tenth scale model of this all-steel Mach 2 research aircraft is shown on the B.A.C. stand together with a full-size specimen of the all-moving tailplane.

British Aircraft Corporation BAC.107 (Two B.S.75). The latest form of this original Hunting project for a short-haul jet transport is shown as a model on the B.A.C. stand in the exhibition tent. A full description appears on page 379.

de Havilland D.H.121 Trident (Three R.-R. RB163). The whole B.E.A. fleet of 24 Tridents appears, in model form, on the Hawker Siddeley stand. The thrust of the RB163 is now quoted by de Havilland as 10,400 lb.

de Havilland D.H.114 Heron (Four D.H. Gipsy Queen 30 Mk. 2). The company demonstrator, G-APEV, in the static park once again, is a series 2D with custom-built interior.

de Havilland D.H.110 Sea Vixen (Two R.-R. Avon 208). A production aircraft with flight refuelling probe, and two Firestreaks and a 150-gal. tank under each wing. Fitted this year with a rain dispersal "collar" around the windscreen, utilizing blast of engine-bleed high-pressure air.

de Havilland D.H.106 Comet 4C (Four R.-R. Avon 525B). First Farnborough appearance of the 4C variant, in the guise of one of the Misrair machines was expected later in the week.

de Havilland D.H.106 Comet 2E (Four R.-R. Avon). One of the two original Comet 2Es, G-AMXD, now re-numbered XN453 and converted to a flying laboratory by the R.A.E. Radio Department, is shown statically. Basic conversions include the installation of up to six table-tops for special radio devices, and additions to the aircraft power-supply systems. A fixed winch in the rear of the cabin facilitates loading of equipment through a hatch in the floor. The present use of this aircraft is for a feasibility study into the use of VLF radio as a navaid, including measurements of changes in the altitude of the ionosphere.

de Havilland D.H.104 Dove 8 (Two D.H. Gipsy Queen 70 Mk. 3). A new company demonstrator, G-ARDH, shows the features of the Series 8—Heron-type high-dome canopy, exhaust thrust augmentation tubes and a custom executive interior with six seats. Collins VHF knife aerials are above and below the fuselage. The first flight was made in February, 1960.

de Havilland D.H.C.2 Beaver (One Alvis Leonides 502/4). The Leonides-powered Mk. 2, G-ANAR, represents the British Army Beaver Mk. 1 in the flying display, and makes its sixth consecutive appearance. Supply packs are carried under the wings.

English Electric P.1B Lightning F.1 (Two R.-R. Avon RA24R). A pre-production model, XG332, with full operational equipment and carrying two Firestreak AAMs, two Aden guns and ventral tank. Four production Lightning F.1s of similar standard from No. 74 Squadron participate in the R.A.F. programme.

English Electric P.11 Lightning T.4 (Two R.-R. Avon RA24R). Second prototype of the first trainer variant of the Lightning, XL629. First prototype flew on May 6, 1959, and the version is now in production for the R.A.F.

Folland FO.144 Gnat (One B.S. Orpheus 100). Two of the pre-production batch of 14 Gnat Trainers, XM691 and XM693, take part in the flying display. Since the first flight on Aug. 31, 1959, the prototype (XM691) has flown for 120 hr. and four more examples have been completed. In its test flight programme, the Gnat Trainer has now been cleared for a three-turn spin each way; recovery can be accomplished simply by releasing the controls. Rotation rate is 60-70°/sec. Rear seat now has windscreen inside the canopy for the hood jettison case, and the Gnat Trainer is to be flown immediately after Farnborough with its cockpit cover removed throughout its full flight envelope to assess buffet during emergency escape. The Folland ejection seats are currently being cleared for zero height down to 90 knots. XM691 has a trial installation of UHF aerials.

Production version of the D.H.110 Sea Vixen showing the rain-dispersal collar under the windscreen.

Gloster Javelin FAW.9 (Two B.S. Sapphire 203/204). An example of the final Javelin mark, XH844, comprising an FAW.7 converted to have re-heat engines, flight refuelling probe, drooped leading edge on wing outer panels, pitch stabilizer in the aileron system and auto-stabilizer in rudder system. Four Firestreaks under the wing. The first Mk. 9 flew in May, 1959, and this mark is now in squadron service.

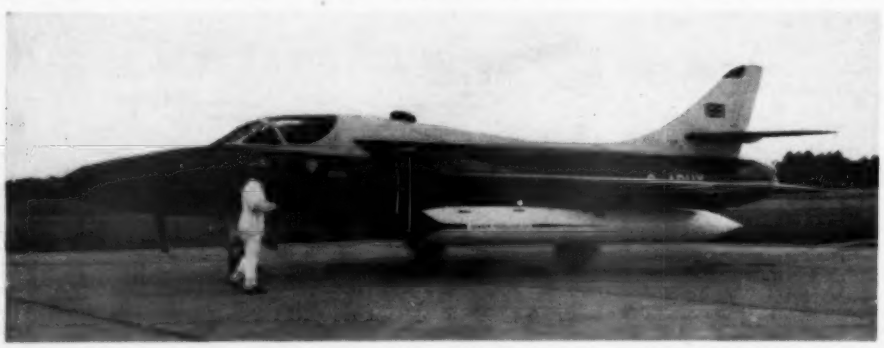
Handley Page H.P.117. A model in the static display shows one of the design studies under this designation for a four-jet 300-passenger tailless transport which, using suction-type boundary-layer control on the wing, would fly across the North Atlantic, claim the makers, for a direct operating cost of £1,650.

Handley Page H.P. 115 (One B.S. Viper). A wind-tunnel model in the exhibition tent indicates the shape of this low-speed research slim delta, now being built for use in the supersonic transport development programme. The engine is carried on the fuselage centre-line at the rear with the intake above the wing.

Handley Page H.P.R.7 Herald (Two R.-R. Dart 527). The first production Herald, G-APWA, is in B.E.A. colours, and has a colourful display of flags on the nose as a souvenir of recent demonstration tours. Handley Page announce that the Herald's take-off weight can be increased to 40,000 lb. for temperatures up to I.S.A. + 13° C. and the max. landing weight can go to 39,500 lb. with small modifications. A 42-in. front fuselage extension is now offered, to increase the Herald's accommodation to 50-56. In the exhibition tent, a model of the H.P.R.8 shows the appearance of this vehicle ferry, freighter and air-bus derivative of the Herald which could carry six cars or 100 passengers.

Handley Page H.P. 80 Victor B.2 (Four R.-R. Conway RCo. 11). A production example of the second Victor mark, making its first appearance. In the exhibition tent, a model shows how a Victor might carry four ALBMs of the size and weight of the Skybolt—two under each wing. Four Victor B.1s (Sapphire 200) from No. 15 Squadron were scheduled to provide the R.A.F. "scramble" on Wednesday and Friday.

Hawker Hunter FR.10 (One R.-R. Avon 207). An example of the latest R.A.F. Hunter variant, XG168 is a fighter reconnaissance version derived from the Mk.6 and intended to succeed the Swift 5 in Germany. It has all the features of the Mk.9 including a strengthened wing and tail parachute plus a new nose section containing a forward-facing and two oblique cameras. First flight of the FR variant was in November, 1958. The 18 Hunter F.G.s of No. 111 Squadron also fly from Farnborough for their aerobatic display.



Under the wings of the Hunter T.66A demonstrator are 360-gal. ferry tanks.

Photographs copyright "The Aeroplane and Astronautics"

Comparative studies of the tails of two Westland Belvederes. XG452 is that in the static display.

Photographs copyright "The Aeroplane and Astronautics"

Hawker Hunter T.66A (One R.-R. Avon 203). This is the Hawker demonstrator, G-APUX, first shown last year. Based on the Indian Air Force T.66 trainer, it is non-standard in having a Dunlop Maxaret brake on the nosewheel and a 13-ft. 6-in. ring-slot tail parachute. It is being shown this year with two very long 350-gal. ferry tanks beneath the wings, which may be carried in addition to two 100-gal. drop tanks. The 350-gal. tanks were developed privately by Hawker Siddeley from 230-gal. units, to which were added removable extra sections; they were first flown on the Hunter on Sept. 3. The 230-gal. tanks are now stressed to 7½ *g* for the ground attack case. With 900 gal. of external fuel, the Hunter has a range equivalent to London-Cyprus, non-stop. Other modifications include variable aileron gearing, and installation of Bendix ADF and DME equipment. G-APUX now bears the badge of No. 8 Squadron, Swiss Air Force, following recent trials there.

Hunting Jet Provost T.3 (One B.S. Viper 102). A standard production example, XN462, in the static park with representative underwing stores. Also a formation of four from the C.F.S. in the R.A.F. flying programme.

Hunting Jet Provost T.4 (One B.S. Viper 200). Following Hunting private-venture development of a Jet Provost with the 2,500-lb. Viper ASV.11, the T.Mk.4 has now been ordered for evaluation by the R.A.F. XN468 in the flying display is one of the development batch.

Lancashire Aircraft Prospector 2 (One A.S. Cheetah X). This Edgar Percival design makes its first appearance in the flying display following development of the Mk.2, G-ARDG, with a Cheetah engine, driving a fixed-pitch metal airscrew. The Prospector is also fitted with spray gear and booms. In the static equipment park is a second Prospector, G-APXW, with Lycoming GO-480-G1 engine and three-blade Hartzell propeller.

Scottish Aviation Twin Pioneer 3 (Two Alvis Leonides 53J/8B). A demonstration model, G-APPH, of the Series 3 with long-stroke Leonides engines.

Short SC.7 Skyvan (Two Continental GTS IO-520). In addition to a 1/24th scale model, the exhibition tent contains a full-size fuselage section illustrating the type of construction with reinforced, Redux-bonded skin.

Short SC.5 Britannic (Four R.-R. Tyne). A 1/24th scale cut-away model illustrates the Britannic in the military rôle with a typical load in the hold. As a troop transport it can carry 204 troops, as a civil transport as many as 249 passengers.

Short SC.1 (Five R.-R. RB.108). In the flying display is XG905, on which the first conversions from hovering to horizontal flight and back were made last April. Something like 100 transitions have now been completed, and the initial phase of the test programme is virtually complete. The first SC1, XG900, is being handed over to R.A.E. Bedford for further development trials, including research into automatic operation and auto-landing.

Vickers VC10 (Four R.-R. Conway). Models on the B.A.C. stand show some of the members of this growing family (see pages 377-378). They include the basic B.O.A.C. VC10, the Super VC10 as ordered also by B.O.A.C., a still larger Super VC10 with more accommodation and range, and a swing-nose freight-carrying version of the latter.

Vickers Vanguard 952 (Four R.-R. Tyne 512). The second of the T.C.A. Vanguards, CF-TKB. The attractive T.C.A. cabin has accommodation for 96 passengers, 46 four-abreast in the first-class compartment and 50 five abreast in the tourist compartment.

Vickers Valiant (Four R.-R. Avon 204). Four Valiants from No. 148 Squadron at Marham were scheduled to provide the R.A.F.'s V-bomber "scramble" from Farnborough on Monday, Thursday and Sunday.

Westland Westminster (Two Napier Eland E.229). The original prototype Westminster, G-APLE, makes its third Farnborough appearance, this time with the faired fuselage, with which it first flew on Jne. 12 this year.

Westland Rotodyne (Two Napier Eland). The original Fairey prototype, XE521, makes its third appearance. New this year are the central fin and rotor head fairing.

Westland Belvedere (Two Napier Gazelle 100). A production example, XG451, of the original Bristol 192. New since last year is the tail arrangement which dispenses with the fixed fins and has simple anhedral on the tailplane, now lower and farther forward; the spats on the rear wheels have also been removed. In the static park, XG452 has an interim tailplane with compound anhedral.

Westland Wessex 2 (Two D.H. Gnome). Models on the Westland stand show the Twin-Gnome Wessex in a military rôle, carrying troops and anti-tank weapons for an airborne assault on an enemy position at 10,000 ft. in rocky country. The Wessex 2 will have two Gnome H.1200s geared together through a coupling gearbox.

Westland W.B.5 Wessex (One Napier Gazelle 160). A production model, XM839, for the Royal Navy, as serving with No. 700H Flight.

Westland Whirlwind HAR.10 (One D.H. Gnome). First flown with a Gnome engine on Feb. 28, 1959, XJ398 now serves as a prototype for the HAR.10. The R.A.F. will convert its Whirlwind 2s and 4s to this standard and will also buy new Whirlwind 10s from Westland.

Westland P.531-2 Sprite (One Blackburn Nimbus). A pre-production model for evaluation by the Army, XP165 is to the new P531-2 Mk. 1 standard with a 6-in. extension in the cabin. The first aircraft to this standard flew on Aug. 4 this year.

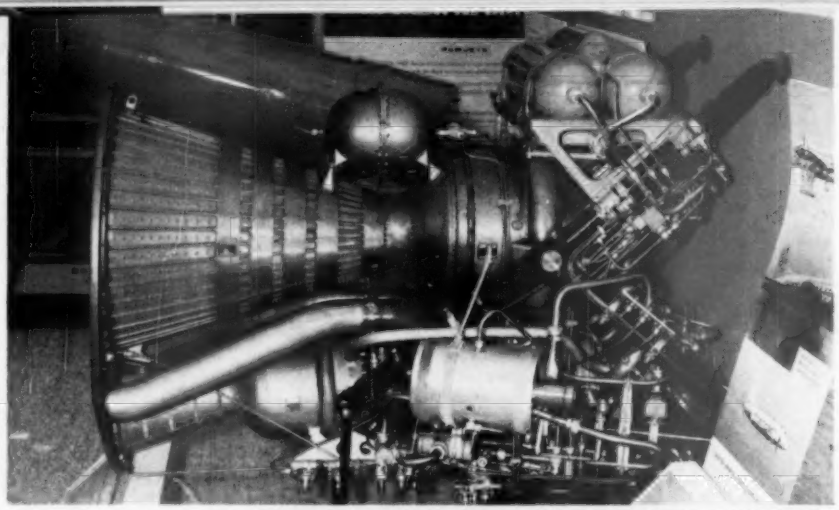
Westland P.531-0 (One Blackburn Turmo). One of three evaluation models of the Sprite for the Royal Navy, XN334 now has a skid chassis and is carrying two dummy homing torpedoes.

Westland Skeeter (One Blackburn Turmo 603). First flown early this year, XM563 has been experimentally fitted with Turmo engine to provide a flying platform for the development of the Louis Neumark auto-stabilizer for the Sprite.

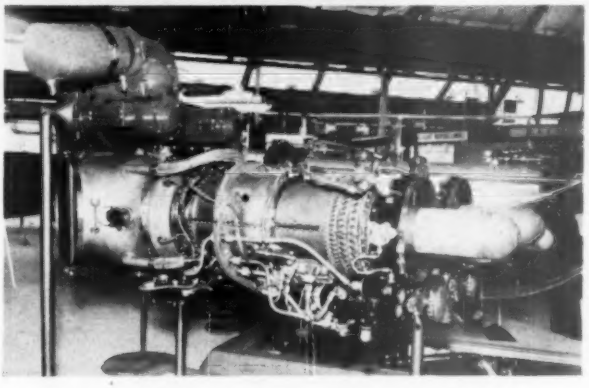
Lancashire's Prospector appears for the first time. This version has the A.S. Cheetah X. Another in the static park has a Lycoming engine.

Report from Farnborough . . . .

Powerplant Notes



The Stentor rocket engine for the Blue Steel stand-off bomb displayed on the Bristol Siddeley stand is a production engine and not a special display unit.



The de Havilland Coupled Gnome powerplant for Westland's Wessex 2 helicopter.

Avon RA.29.—Rolls-Royce, Ltd. Civil Avon for the Comet 4 and Caravelle airliners. Overhaul life raised from 1,000 to 2,000 hr. after less than 20 months in service. The Avon 524 exhibited was removed from a B.O.A.C. Comet 4 on Sept. 1 after running 1,995 hr. without overhaul; it is to be reinstalled to run to an overhaul life of 2,300 hr. Caravelle 3 has RA.29/3 with 11,400 lb. thrust, with two-position final nozzle. Latest production version is RA.29/6 for Caravelle 6; it has additional compressor stage. Initial rating of this version will be 12,200 lb., to be increased later to 12,725 lb. First ran (RA.29/1) March, 1956; type test, March, 1957.

Avon RB.146.—Rolls-Royce, Ltd. Latest military Avon, developed from the RA.24 by addition of a zero compressor stage—shown with afterburner; thrust without reheat, 13,220 lb. This is a fully supersonic engine which powers English Electric Lightning and Saab Draken; a version of Dassault Mirage 3 is offered with this engine.

BS.53.—Bristol Siddeley Engines, Ltd. First appearance of the ducted fan lift/thrust engine which powers the Hawker P.1127 VTOL fighter. No official performance figures available; maximum thrust believed to be 15,000 lb. plus. Four movable jet nozzles direct the front fan and turbine exhaust thrust in the required direction. The engine is exhibited with lift/thrust nozzles moving; diagrams show its application to P.1127 and to a hypothetical VTOL assault transport with two BS.53s. Flight engine now installed in the P.1127 and first flight expected in October. BS.53 first ran in August, 1959.

BSRJ.824.—Bristol Siddeley Engines, Ltd. First showing of this 18-inch diameter ramjet intended for operation at high altitude and high supersonic speed. A hypothetical intake configuration has been chosen for the display ramjet. This ramjet is a possible powerplant for advanced version of the Bloodhound SAM. No thrust figure available.

Conway RCo.12.—Rolls-Royce, Ltd. A complete engine pod is exhibited as supplied by Rolls-Royce for the Boeing 707-420. It comprises an RCo.12 Conway by-pass engine rated at 17,500 lb. minimum thrust, with thrust reverser, noise suppressing nozzle and cowlings, all designed and manufactured by Rolls-Royce. The RCo.12 is in service in Boeing 707-420s and Douglas DC-8/40s.; its initial overhaul life is 1,000 hr. Latest civil Conway is the RCo.42, of 20,250 lb. thrust, under development for the Vickers VC 10. Latest military version is the RCo.17 of 20,600 lb. thrust. First ran (RCo.10), July, 1957. Entered airline service, March, 1960.

Double Spectre DSpe.D.1.—The de Havilland Engine Co., Ltd., HTP/kerosene rocket engine with fixed-thrust Spectre 4 mounted above variable-thrust Spectre 5; thrust range 800-16,000 lb. Powerplant for Blue Steel test vehicles; first powered flight in this rôle, Oct. 6, 1959. First ran September, 1958.

Eland 504.—D. Napier and Son, Ltd. Eland single-shaft turboprop as installed in the Canadair 540 and military CL-66. Take-off power, 3,500 e.h.p. Special versions of the Eland power the Westland Westminster helicopter and Rotodyne prototype. First ran June, 1956; type test February, 1958.

Gamma 201.—Bristol Siddeley Engines, Ltd. Four-chamber HTP/kerosene rocket engine which powers the Black Knight re-entry research vehicle. Thrust rises from 16,400 lb. at sea level to 19,000 lb. outside the atmosphere. First ran August, 1956; type test October, 1957.

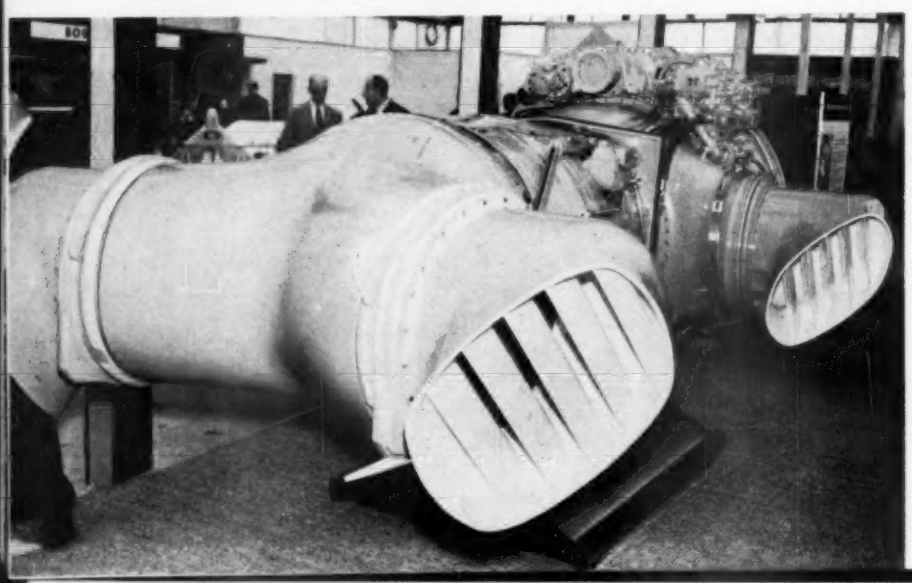
Gazelle.—D. Napier and Son, Ltd. Cut-away and rotating exhibit of the standard Gazelle free-turbine powerplant which powers the Westland Wessex and Belvedere helicopters. Emergency rating, 1,650 s.h.p.; one-hour rating, 1,465 s.h.p. Engine currently undergoing tropical trials; M.o.A. 150-hour helicopter type approval at 1,650 s.h.p. was received in September, 1959. Also exhibited are research compressors for possible future Gazelles. The most advanced has 11:1 pressure ratio and 17 lb./sec. mass flow (compared with 6.2:1 ratio and 16.6 lb./sec. flow for standard Gazelle). A model is also shown of the new Gazelle 512 which has no reduction gearing.

Gipsy Major 215.—The de Havilland Engine Co., Ltd. Turbo-supercharged piston engine in production for the Westland Skeeter helicopter. It has a one-hour rating of 220 b.h.p. maintained up to 8,000 ft. in I.S.A. conditions. First ran February, 1957; type test November, 1957.

Gnome H.1000.—The de Havilland Engine Co., Ltd. Licence-built version of the General Electric T58 turboshaft; in production for R.A.F. Westland Whirlwind helicopters. Rated at 1,050 s.h.p. for take-off. An up-rated version, the H.1200 of 1,250 s.h.p., is to be available in 1961. First run (British-built H.1000), June, 1959.

Gnome P.1000.—The de Havilland Engine Co., Ltd. A turboprop powerplant based on standard Gnome H.1000 turboshaft engine. An up-rated version, the P.1200 will give 1,150 s.h.p. at take-off. Development running will begin this month.

Coupled Gnome H.1200.—The de Havilland Engine Co., Ltd. A coupled version of the Gnome H.1200 which will power Westland Wessex 2 helicopter. Powerplant comprises two standard H.1200s having a



Making its first public appearance, the BS.53 lift thrust engine for the Hawker P.1127 VTOL fighter has pride of place on the company's stand. A flight engine has now been installed in the airframe.

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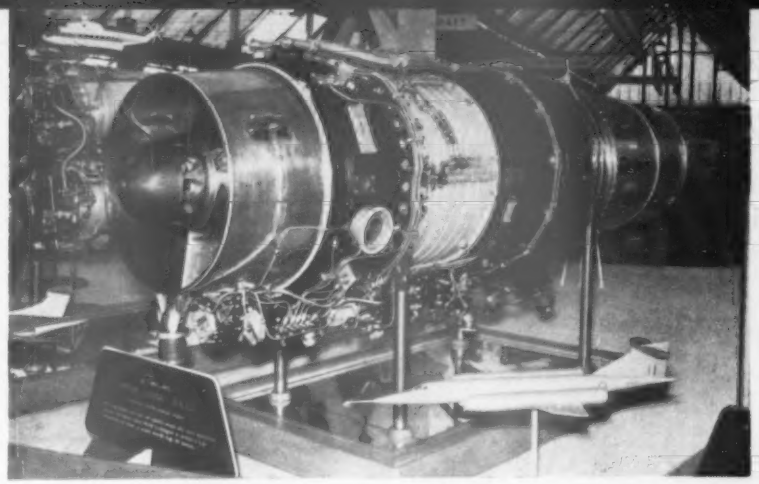


In production for the Blackburn Buccaneer, the de Havilland Gyron Junior DGJ.2 is noteworthy for the high degree of bleed air available from it for airframe boundary layer control purposes.

common gearbox allowing each engine to drive rotor individually if necessary. Weight, 1,034 lb.; maximum output, 2,500 s.h.p. Scheduled to run early 1961.

Gyron Junior DGJ.2.—The de Havilland Engine Co., Ltd. The Mk. 101 interim production version of the engine which powers the Blackburn Buccaneer (NA.39) Naval strike aircraft. Develops 7,100 lb. thrust plus large quantity of compressor bleed air for high-lift devices. Variable-incidence first-row stator blades as well as variable-incidence inlet guide vanes are used. First ran (DGJ.1) August, 1956.

Gyron Junior DGJ.10.—The de Havilland Engine Co., Ltd. Supersonic version of the Gyron Junior with a 2,000° K. reheat system; two DGJ.10s power the Bristol 188 research aircraft. Claimed to be first British turbojet developed for, and to be flown at, speeds above Mach 2.5. Static thrust, 10,000 lb., increased to 14,000 lb. by reheat, to be flight-tested in a Javelin. First ran October, 1957.

Leonides Major Series 750.—Alvis, Ltd. Helicopter powerplant version of the 14-cylinder twin-row air-cooled radial Leonides Major. Minimum take-off power, 755 s.h.p. First ran June, 1955.

Leonides Series 531.—Alvis, Ltd. Long-stroke version of the 9-cylinder air-cooled radial Leonides piston engine for fixed-wing aircraft. Take-off power, 640 b.h.p. First ran October, 1957; type test August, 1958.

Leonides Series 554.—Alvis, Ltd. Helicopter version of the long-stroke Leonides piston engine. Output, 600-625 b.h.p.

Nimbus (A.129).—Blackburn Engines, Ltd. Complete and sectioned examples of this 970-s.h.p. free-turbine engine are exhibited. The Nimbus is in production for the Westland Sprite helicopter and has been specified for the SRN.2 Hovercraft. First ran August, 1958; type test at 970 s.h.p. to be started this month.

Olympus BOl.21. — Bristol Siddeley Engines, Ltd. First public appearance of this particular Olympus variant. It has been developed from the Olympus 201 by the addition of a zero compressor stage. Thrust without reheat, 20,000 lb. The Olympus 21 is a possible powerplant for advanced Avro Vulcan bombers.

Olympus BOl.21 with reheat.—Bristol Siddeley Engines, Ltd. As displayed, the Olympus 21 with fully variable Bristol Siddeley Solar reheat system is quoted as giving 33,000 lb. total thrust. This engine represents a stage in the development of the reheat Olympus for the TSR-2 supersonic strike aircraft.

Orpheus 803.—Bristol Siddeley Engines, Ltd. Cutaway exhibit of the 5,000-lb. thrust Orpheus. This engine is in production for the Fiat G91 NATO strike fighter and air reconnaissance and trainer variants. The Orpheus is built under licence in India, Italy and Germany.

Proteus 705.—Bristol Siddeley Engines, Ltd. The engine of this type exhibited has been removed from a B.O.A.C. Britannia after 2,400 hr. service since last overhaul. A display of Proteus components shows their condition after a long service life. Engine first ran July, 1957; type test July, 1957.

RB.108.—Rolls-Royce, Ltd. Two coupled jet-lift engines as used in Short SC.1 VTOL research aircraft are displayed. Rated thrust, 2,010 lb. per engine plus full air bleed; thrust/weight ratio, 8.1 : 1. The latest Rolls-Royce jet-lift engine, the RB.162, will be simpler than the RB.108 and will incorporate plastics; it is said to give 16 lb. thrust for each lb. of weight. Total RB.108 running time, 4,500 hr. First ran 1955.

RB.141—Rolls-Royce, Ltd. First showing of a genuine RB.141; the engine was exhibited in engineering mock-up form last year. Production deliveries of this by-pass engine will start late in 1961. No definite orders have yet been received, but the engine is specified for two versions of the Caravelle. Initial thrust rating, 15,000 lb.; maximum continuous thrust, 14,100 lb.; dry weight, 3,650 lb.; by-pass ratio, 0.7 : 1; pressure ratio 16.75 : 1. Eight engines running on development. RB.141 first ran November, 1959. Test-running of the other Rolls-Royce second-generation by-pass engine, the RB.163 for the D.H. Trident, is scheduled to begin in November, with production deliveries late in 1962.

Rover 1S/60.—Rover Gas Turbines, Ltd. First display appearance of the turbo-prop version of the 1S/60 airborne auxiliary power unit for the Vulcan B.2 bomber. As a turboprop for light aircraft it delivers 70 b.h.p. for take-off and 60 b.h.p. for cruise. This engine has flown with a fixed-pitch propeller in the Currie Wot light biplane.

Soar. — Rolls-Royce, Ltd. Expendable supersonic turbojet first ran in 1952: total running time 750 hours. Weight 275 lb., thrust 1,810 lb. This engine is displayed to illustrate Rolls-Royce's lengthy experience with turbojets having specially high thrust/weight ratios.

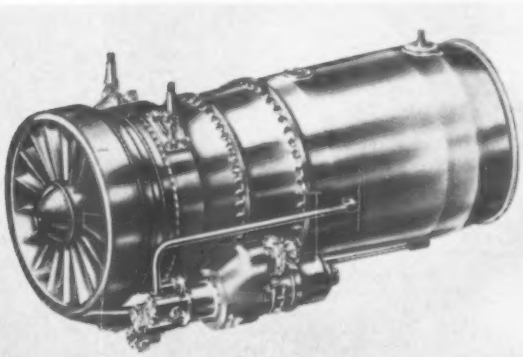
Scorpion.—D. Napier and Son, Ltd. Single-chamber HTP/kerosene rocket engine designed as boost unit for fighter aircraft or sustainer motor for missiles. Thrust 2,500-3,000 lb. Double and triple versions of this rocket engine also available.

Stentor BSSt.1-1. — Bristol Siddeley Engines, Ltd. On show for the first time this two-chamber HTP/kerosene rocket engine is in production at Coventry for operational Blue Steel stand-off bombs. Engine number 31 is exhibited and is obviously an operational rather than a display engine. It has a large fixed-thrust chamber, producing four-fifths of the total thrust, mounted above a smaller variable-thrust chamber. No details available.

Turmo.—Blackburn Engines, Ltd. A 425-s.h.p. free-turbine engine which powers early versions of the Westland P.531 helicopter. One Skeeter helicopter is experimentally fitted with the Turmo. First ran June, 1955; type test December, 1956.

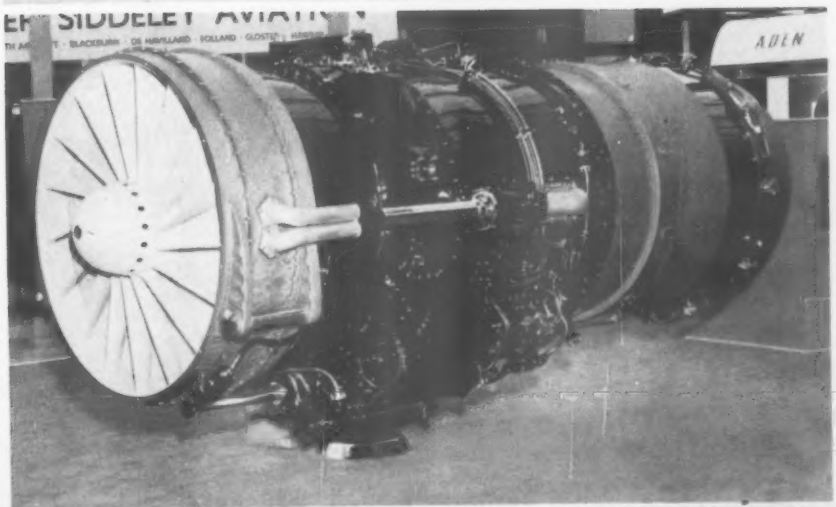
Tyne RTy.1.—Rolls-Royce, Ltd. The 4,785-e.h.p. Tyne 1 two-spool turboprop is in production for B.E.A. Vanguards. The RTy.11 for T.C.A. Vanguards is rated at 5,325 e.h.p. and the RTy.12 for the Canadair CL-44 at 5,500 e.h.p. Compressor heat-treatment problems are now overcome and the Tyne is expected to enter airline service early in 1961. First ran July, 1957.

Viper ASV.11.—Bristol Siddeley Engines, Ltd. A 2,500-lb. thrust turbojet which powers the Macchi MB 326 trainer and the Jindivik 3 target drone, and will be installed in latest Jet Provost 3 trainers. These engines are to be manufactured under licence in Italy by Piaggio. First ran January, 1957.



First picture of the Bristol Siddeley BS.78 ducted fan engine for the Avro 771 and the BAC.107. It has a high by-pass ratio and gives a thrust of 7 350 lb.; its weight is 1,485 lb.

Another powerplant newcomer to Farnborough is the Rolls-Royce RB.141 by-pass turbojet for the de Havilland DH.121 Trident.



HENRY WIGGIN
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Report from Farnborough . . . .

New in the Static Show

PROMINENT among the diverse range of equipment on display are the industry's new products and developments. In particular, accessories and components for the new aircraft now under development, such as the Vickers VC10, are well to the fore.

For this turbojet transport Elliott Brothers, for example, are supplying the complete flight control system, comprising the Bendix/Elliott PB.20 Series equipment and the Bendix 100 Series integrated instrument and flight director system which the company is licensed to manufacture in this country. A working display of the navigational side of the 21 Series communication and navigation equipment is also on the Elliott stand.

Boulton Paul are featuring a powered flying control unit and a spoiler jack for the VC10. Illustrating the trend towards economy in bulk and weight in such equipment, the former exhibit is typical of the company's range of self-contained electro-mechanical control units. The spoiler consists of a double-acting hydraulic jack controlled by an integral rotary control valve.

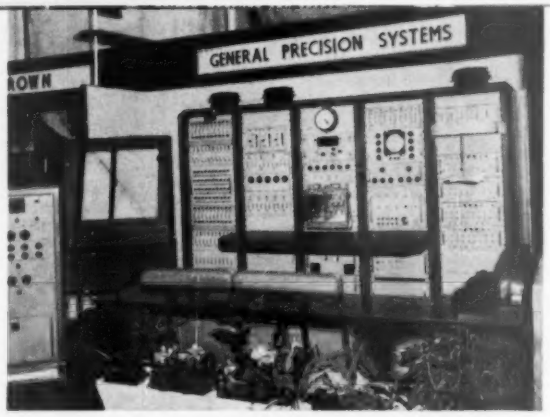
Other components for the VC10 on show include Normalair liquid oxygen converters incorporating a crew reserve circuit, a mock-up of the compressor for the aircraft's cooling system and a diagram of the new Normalair electro-pneumatic pressure control system. Plessey feature a channel from the VC10 AC generation system comprising a brushless generator, control panel, voltage regulator and a transformer package. A static aircraft inverter and the recently developed Plessey constant speed drive/starter can also be seen.

An item of particular interest on the General Electric stand is a demonstration—in ¼-scale model form—of their new Z.A.707 visual glide path indicator unit designed for use in the R.A.E. approach aid system. Four new types of airport lighting equipment: a flasher unit for taxiway lights; a quadruple obstruction light, and two types of runway blister lights, can also be seen on the G.E.C. stand.

Among the Ministry of Aviation exhibits are a broadband telemetry system developed by the R.A.E. at Farnborough for displaying and recording on the ground instrument movements and flight information from missiles. Also worthy of study in the M.o.A. display are examples of two missile and aircraft magnetic tape recorders, the provision of a radar-controlled marker in the field of view of an optical tracking instrument for missile flight-testing applications, and a demonstration of rain erosion measurement techniques.

New technical developments in processes and materials are featured in a number of exhibits. For example, the Northern Aluminium stand has three new products—Noral B19S aircraft plate which retains good mechanical properties at elevated temperatures; a roll-bonded heat exchanger plate known as Noralduct, and a hollow sheet incorporating ducts which are integrally formed during rolling. Another aluminium alloy for high temperature applications—Hiduminium R.R.58—is shown by High Duty Alloys, who also feature a pressure die casting produced by an entirely new process, which gives greater strength and improved surface finish.

Advances in the manipulation of materials from high stress steels to reinforced plastics are illustrated by Bristol Aerojet. Work in this field includes the manufacture of thin-wall tubes by helical welding and the production of lightweight stiff structures by the controlled chemical removal of metal. In contrast British Paints feature their 1400 Series of sealants which are now coming into general use in the sealing of integral fuel tanks and aircraft pressurized areas.



This aerodynamic research computer is a dominant feature of the G.P.S. exhibit.

With the ever-growing application of airborne electronics, close attention is being paid to the provision of the right environment for the equipment. In this context, a self-contained vapour cycle cooling package for maintaining the working temperature of certain airborne electronic equipment within operational limits, exhibited by Sir George Godfrey and Partners, is of particular interest. In this, a water glycol mixture is circulated around the equipment containers and then passed through the evaporator in the refrigeration package and back to the containers. A static self-contained air cycle cooling system designed for guided missile applications is also on this company's stand.

New maintenance and servicing units on show include the Vernon static inverters designed to replace the smaller sizes of motor alternator sets used for inverting DC input to AC. These units have outputs of 100 VA 400 c.p.s., 250 VA 400 c.p.s., 250 VA 1,000 c.p.s. and 250 VA at 2,400 c.p.s. In the outside display there is also the Houchin Mk. 3 60kVA 400 c.p.s. ground power unit.

A series of Morfax ground service and transport stands for the Rolls-Royce Tyne, including a special air freight stand which can be accommodated in the freight hold of the Vickers Vanguard, can be studied in the outside equipment display. An improved hydraulic elevating strip/build platform for the vertical assembly of the larger turbine engines is also on display.

New aircraft and missile equipment is prominent in the electrical and electronic fields. Control gear components with as few moving parts as possible can be seen on the English Electric stand, together with two new 200-v. 400-c.p.s. brushless generators, one air cooled and the other oil cooled, developed during the past year.

Smiths Aviation Division is featuring its latest mark—S.E.P.5—of autopilot, the Para-Visual Flight director and its new-presentation 100,000-ft. servo altimeter, while a lightweight helicopter autopilot is displayed by Louis Newmark. The Gyrotwin aircraft dynamic reference system based on the Master Reference Gyro is featured by S. G. Brown, who are also showing for the first time a true north seeking gyro compass which is suitable for helicopter application.

The Sperry stand portrays developments by examples which include a cutaway of a British-made Rotorace directional gyro which is incorporated in Gyrosyn compasses, a vertical gyro for the D.H. 121 instrumentation system and the Sperry Twin Gyro Platform, an attitude and directional reference for military aircraft. Two new instruments, a transmitting and indicating accelerometer for measuring manœuvre, turbulence and heavy landing accelerations, and an eight-channel fatigue meter, are featured by Mechanisms, Ltd.

A "first" in airborne communication and navigation equipment at the show is the Marconi "Sixty Series." Comprising the AD 160 navigation system, the AD 260 navigation system and the AD 360 automatic direction finder, this equipment employs sealed module construction and transistors in the majority of its units. In the simulator field the Air Trainers Link Division of G.P.S. is demonstrating its most interesting four-station automatic radio aids unit which has been designed for attachment to single seat Link trainers to give them the ability of simulating radio navigation aids.

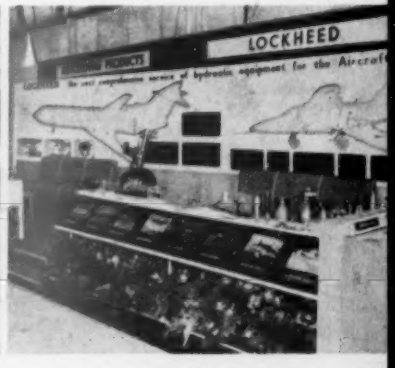
On the Smiths Aviation Division stand is this photograph of the cockpit mock-up of the D.H. Trident with a coaming installation of the para-visual director system. The controller unit, attitude director and flight compass for the Smith S.E.P.5 auto-pilot are below.

Report from Farnborough . . . .

Round the Stands

More Accessories Than Ever

(Continued on page 376)



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This year's static show contains more than 380 stands compared with the previous record of 376. The exhibition has grown to include 40 stands in the outside equipment display, 13 in the missile park and three in the radar park.

Report from Farnborough . . . .

(*Continued from page 375*)

More Stands in the Big Tent

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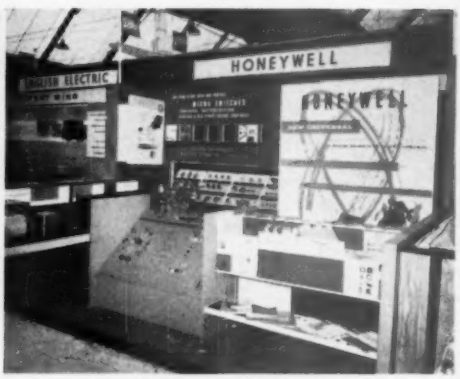

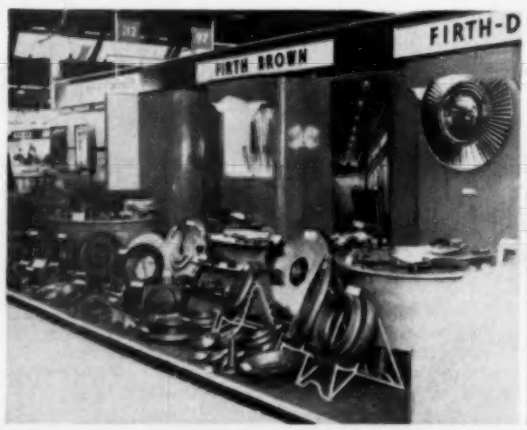

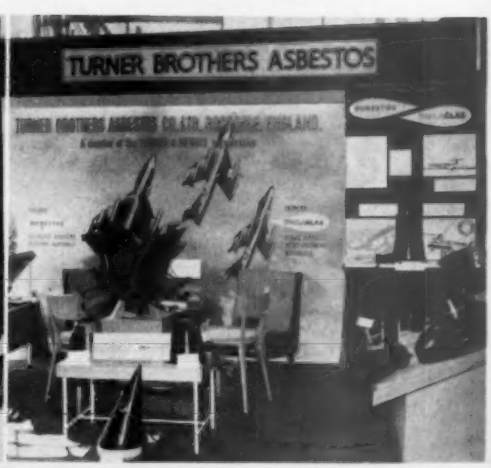

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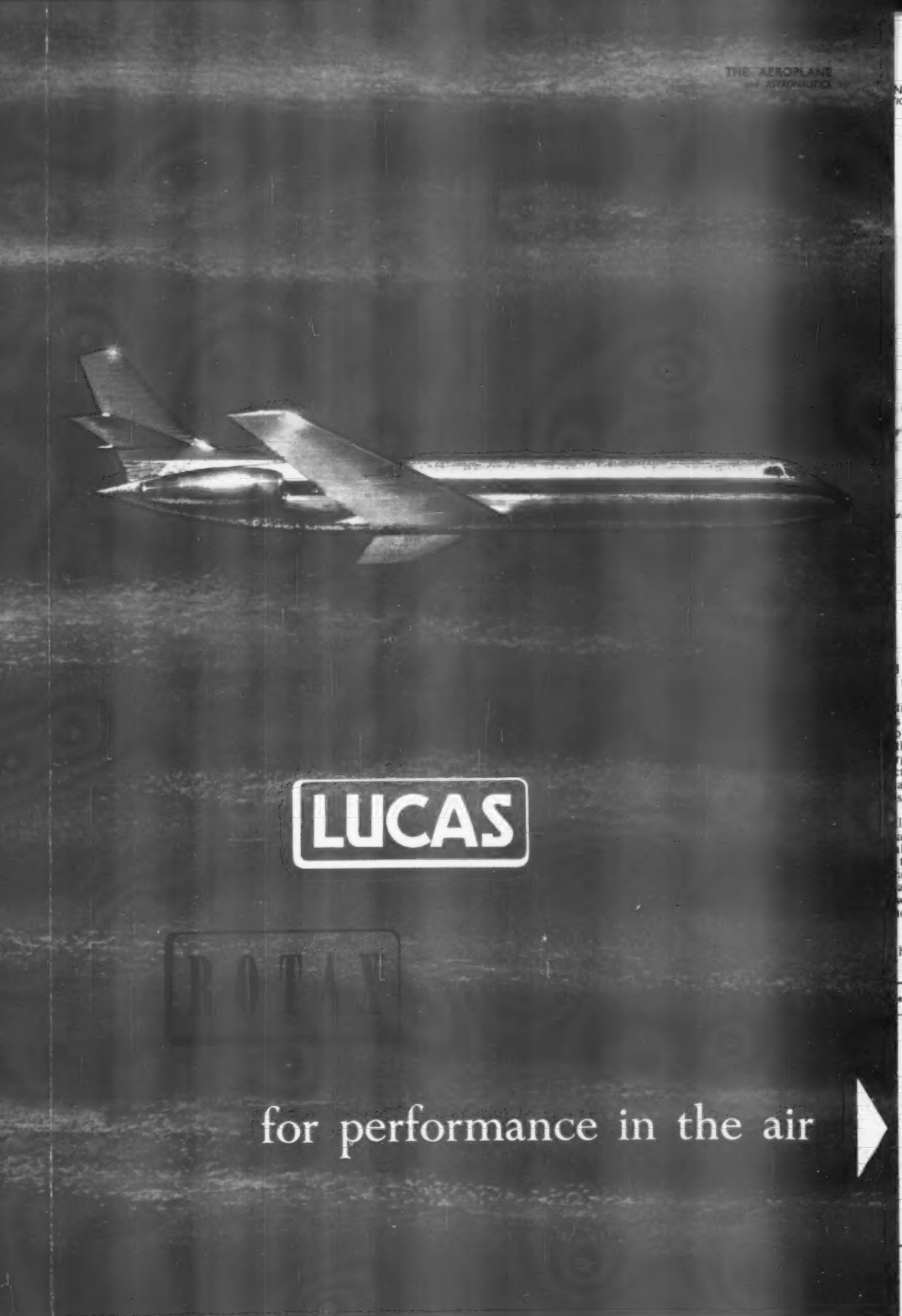
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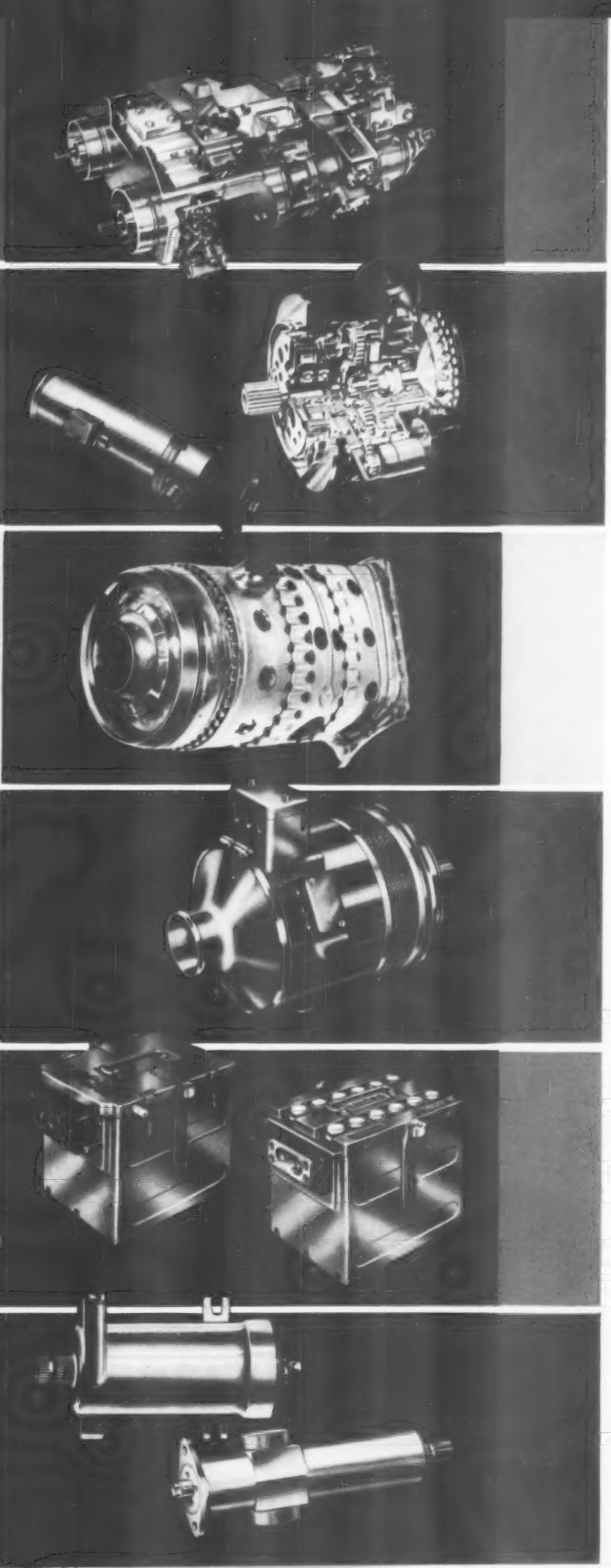

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Report from Farnborough . . . .

VC10s for Freighting

ALL-FREIGHT versions of the standard and Super VC10, and associated cargo-handling systems, were announced at Farnborough this week. In addition, new payload and performance figures for a still - more - developed passenger-carrying Super VC10 were issued and these data are included in the table below which provides a comparative breakdown of the variants in the growing VC10 family.

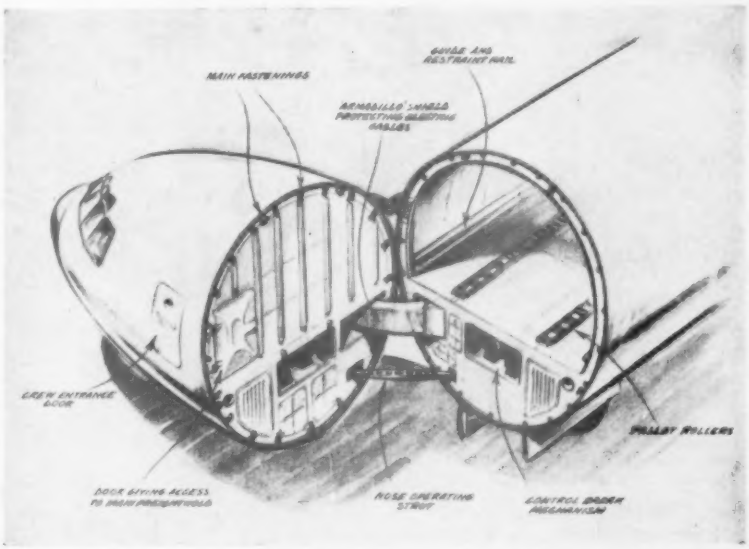
Designed both to meet and to develop the expected long-haul-cargo traffic expansion during the middle 1960s, the two all-freight VC10s are uncompromised minimum-operating-cost load carriers and their conception is combined with that of an overall terminal handling and loading system. The basis of one variant of this terminal system is illustrated on the next page and is particularly applicable to the freighter VC10s which will have nose loading. The major part of a pre-palleted or containered load will enter the aircraft at a point where the nosewheel can be used to provide a constant-level support. Freight for the underfloor holds will be simultaneously loaded, in containers or otherwise, through three hatches.

The Super VC10 freighter, which will be powered by developed Rolls-Royce Conways each giving approximately 24,000 lb. of static thrust, will have a weight-limited payload of 106,000 lb. and a gross hold volume of 11,770 cu. ft. When making the maximum use of pre-loaded containers or pallets—essential requisites for fast turn-rounds with big-capacity aircraft—the normal maximum weight payload will be between 92,750 lb. and 97,000 lb.

With maximum fuel (160,000 lb. less 352 lb. residual), and assuming a reserve for two hours, the non-stop range will be 3,950 naut. miles with a payload of 59,677 lb. With the same reserves a maximum payload can be carried over a range of 2,260 naut. miles. According to freight density the shorter-fuselage standard VC10 freighter will have a maximum payload of 80,000-90,000 lb.

Assuming a realistic contained volume of 75% of the gross volume, giving a space-limited payload of 92,400 lb. at an average freight density of 10.2 lb./cu. ft., and a utilization of 3,000 hr./year, the direct cost of the Super VC10 freighter, to the A.T.A. formula, works out at between 5.6 and 6.2 U.S. cents per ton/naut. mile over sectors of 1,200 to 2,400 naut. miles.

The freighter's geometry of wings and rear fuselage is similar to that of the passenger-carrying Super VC10, but the forward fuselage is shorter than that of the fully developed passenger variant (see data box), the nose is hinged and stiffening will be introduced into wings and fuselage to absorb the higher design loads. All windows, doors and emergency exits which are not necessary to a freighter role have been removed and the floors of the main and lower compartments have been designed to take twin roller tracks, with guides and a latching system for the pallets.



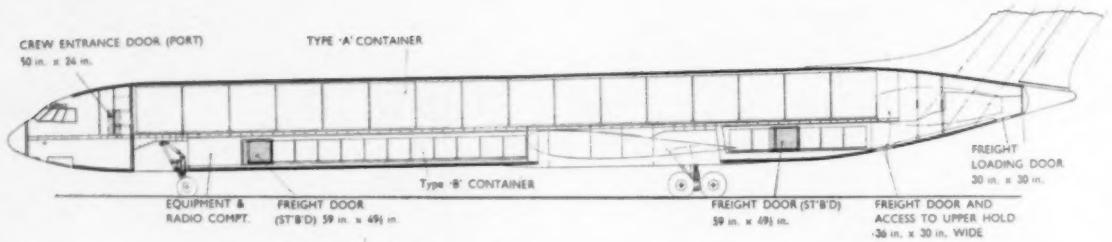
Direct forward loading will be used by the VC10 and Super VC10 freighters and this sketch shows the hydraulically operated hinging of the nose aft of the flight deck. It is supported in its open position by a pair of hinges with a base of approximately five feet.

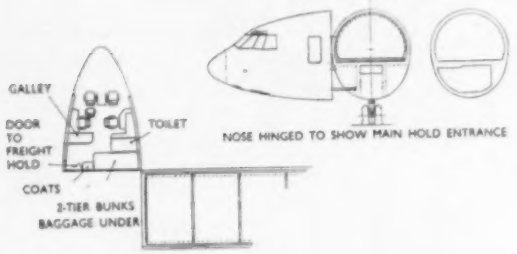
The hinge-point for the hydraulically operated nose section is just behind the flight deck, which is a point of low stress so that the structural weight penalties have been kept to a minimum. The only disadvantage in hinging the nose rather than the tail is that concerned with the need for a larger quantity of electrical wiring to cross the joint. The practicability of taking wiring looms around the hinge has already been assessed by laboratory work involving 10,000 reversals of a test assembly under varying temperature conditions.

The 16 containers for the main hold are based on pallets measuring 10 ft. 3 in. in width and 7 ft. 4 in. in length and will have a maximum height of 7 ft. 4 in. They are suitable for normal road and rail transport in both the U.K. and the U.S.A. Their unloaded weight is 620 lb. each and their average loaded weight will be 4,000-5,000 lb. Special containers have also been designed for the underfloor holds other than the lower rear compartment, which will take hand-packed freight. These containers are 3 ft. 8 in. wide, 8 ft. 4 in. long and 3 ft. 9 in. high.

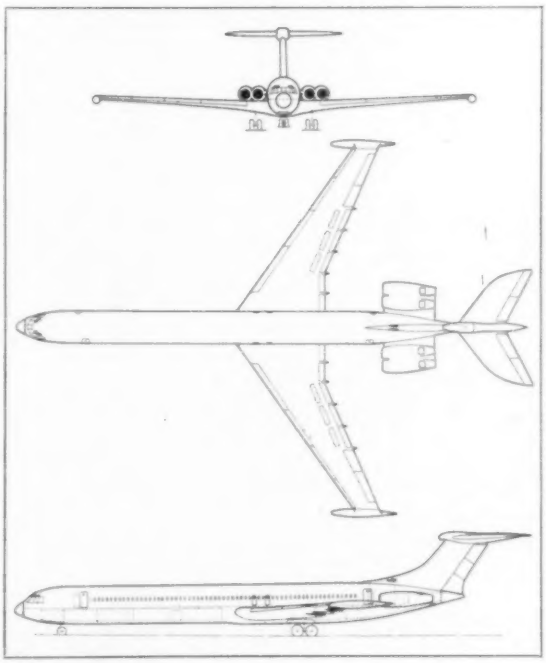
With nose-loading and the cargo handling system which has been developed by Vickers the VC10 will be able to taxi up

		VC10	Super VC10 (B.O.A.C.)	Super VC10 (dev.)	Super VC10 (freighter)
Dimensions					
Span	ft./in.	140 0	146 0	146 0	146 0
Overall length	ft./in.	158 10	186 0	196 6	194 3
Overall height	ft./in.	39 1½	39 6	39 6	39 6
Gross wing area	sq./ft.	2,800	2,800	2,800	2,800
Total cabin length	ft./in.	91 4	118 0	129 9	121 0
Interior max. width	in.	140	140	140	140
Interior max. height	in.	90	90	90	93.75
Main cabin volume	cu. ft.	—	—	—	9,000
Lower hold volume (fwd.)	cu. ft.	1,350	2,000	1,000	1,570
Lower hold volume (rear)	cu. ft.			1,300	1,200
Max. passengers		150	212	222	—
Weights					
Max. ramp weight	lb.	301,000	—	362,000	—
Max. t.-o. weight	lb.	299,000	347,000	360,000	373,000
Max. landing weight	lb.	197,500	241,000	245,000	283,000
Max. zero fuel weight	lb.	176,500	219,000	222,000	260,500
Payload	lb.	38,000	58,000	53,000	106,000
Fuel (at 8 lb./imp.gal.)	lb.	138,000	150,000	160,000	160,000


CREW ENTRANCE DOOR (PORT)
50 in. x 24 in.
TYPE 'A' CONTAINER
Type 'B' CONTAINER
FREIGHT LOADING DOOR
30 in. x 30 in.
EQUIPMENT & RADIO COMPT.
FREIGHT DOOR (ST'B'D) 59 in. x 49½ in.
FREIGHT DOOR (ST'B'D) 59 in. x 49½ in.
FREIGHT DOOR AND ACCESS TO UPPER HOLD 36 in. x 30 in. WIDE



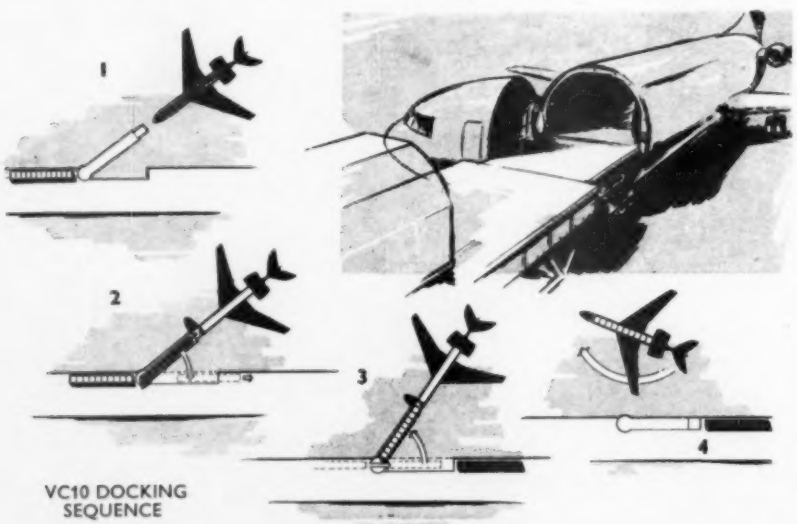
Section views of the VC10 showing the 16 containers in the main hold, the 18 smaller containers in the lower rear and forward holds and the volume available for hand loading in the aft compartment. Below are general arrangement drawings of the developed passenger-carrying Super VC10.



to the swinging jetty and to move away under its own power as soon as the unloading and loading operation has been completed.

As will be seen in the drawing on this page, the aircraft is taxied to a marked position on the apron and the empty jetty is rotated into position with a connecting bridge taking up the final adjustment of position. When the container train from the main hold has been run on to the jetty, this is swung back, unloaded, and reloaded with a train of outgoing containers in order according to destination. Meanwhile the containers in the two main underfloor compartments are being off-loaded and replaced with new loaded containers, and the rear hold is reloaded with hand-packed freight.

The drawing of the fuselage shows the positions of the various holds, with 16 "Type A" containers in the main compartment, 12 "Type B" containers in the lower forward compartment and six similar containers in the lower rear compartment. The volume available for loose freight in the lower rear compartment, excluding the space above the hatches, is 425 cu. ft. With the contained volume of 8,832 cu. ft. the total available volume of the Super VC10, assuming a maximum use of containers, is 9,257 cu. ft. by comparison with the gross hold volume of 11,770 cu. ft. The total empty weight of the 44 containers is 12,250 lb. and the maximum payload is thus 92,750 lb., allowing a theoretical average freight density of about 10 lb./cu. ft.—which is lower than the average density of cargo which is at present being flown and should permit a high weight load factor to be maintained when unlimited traffic is available.



VC10 DOCKING SEQUENCE

These drawings show the loading sequence with the Vickers' swinging jetty. In (1) the VC10 has been taxied into position to off-load; in (2) the train of arriving containers has been moved on to the jetty; in (3) the off-loaded containers have been moved from the jetty and been replaced by onward freight in readiness for nose-loading; and in (4) the VC10 is taxi-ing away from its apron position.

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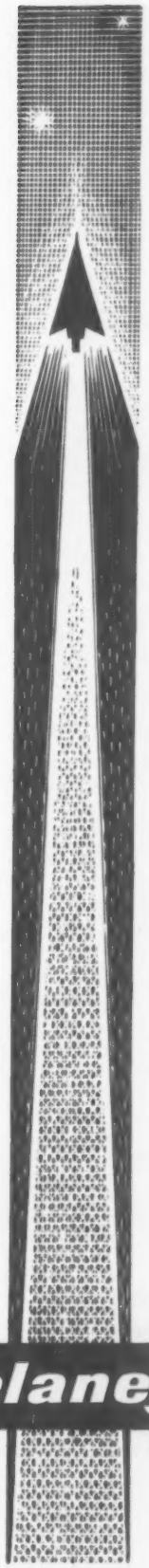

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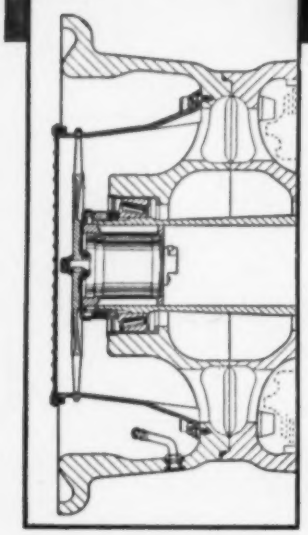

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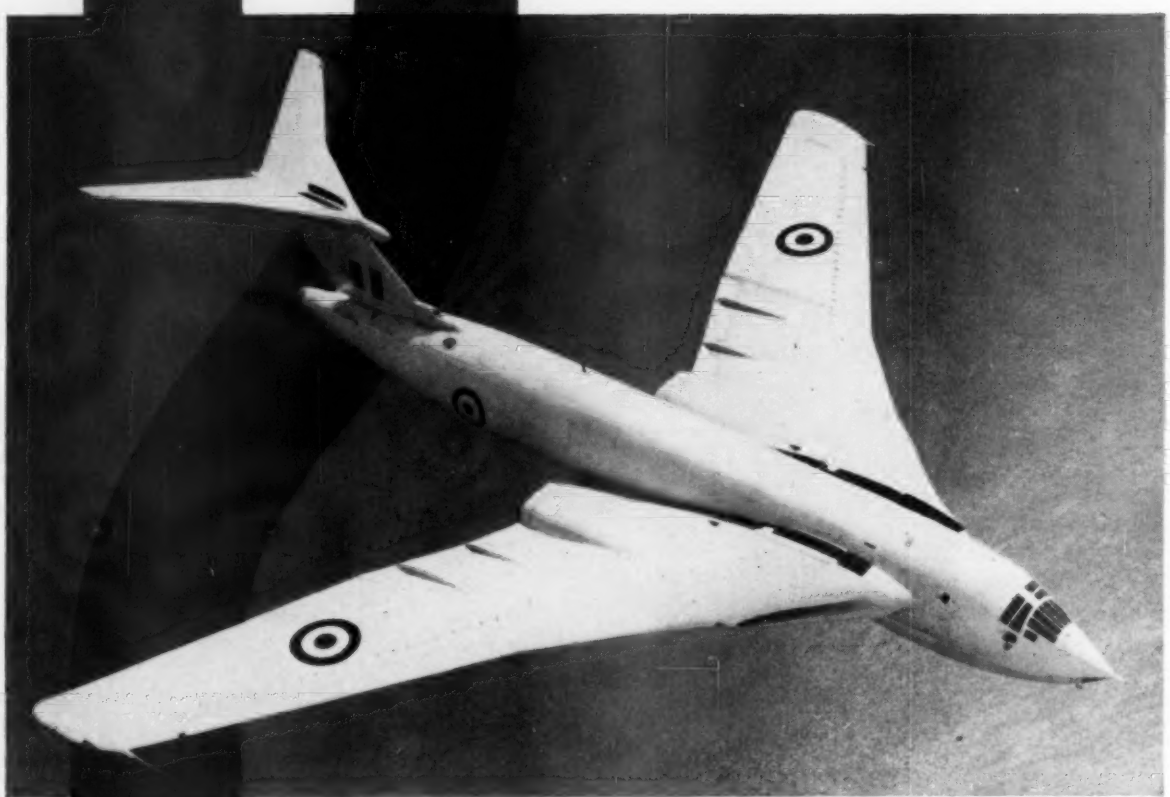

Victor 2s are even more potent versions of the sonic Victor 1s in V-bomber service with the Royal Air Force—and still the largest aircraft to have breached the sound barrier.

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Report from Farnborough . . . .

The BAC-107

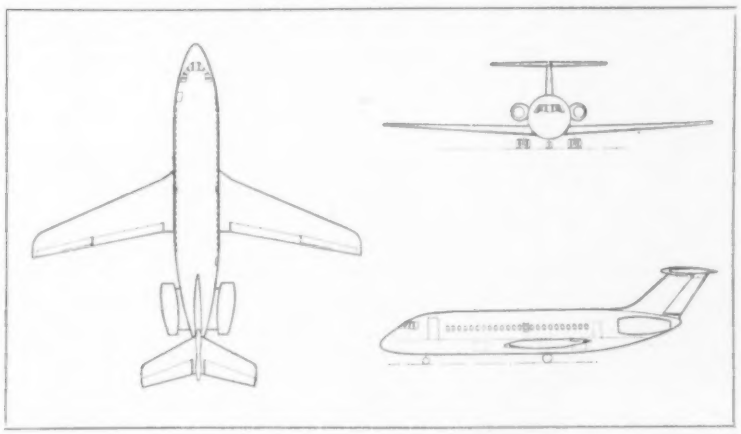
SINCE Hunting Aircraft, Ltd., became a subsidiary company of the British Aircraft Corporation, the original Hunting 107 project has been the subject of joint development by Hunting and Vickers-Armstrongs (Aircraft), Ltd. The first full release of information on the developed BAC-107 is made this week at Farnborough, where a model is on display. Important changes which have been made are an increase in fuselage diameter to permit five-abreast seating, the adoption of a T-tail, and the decision to use small-diameter windows.

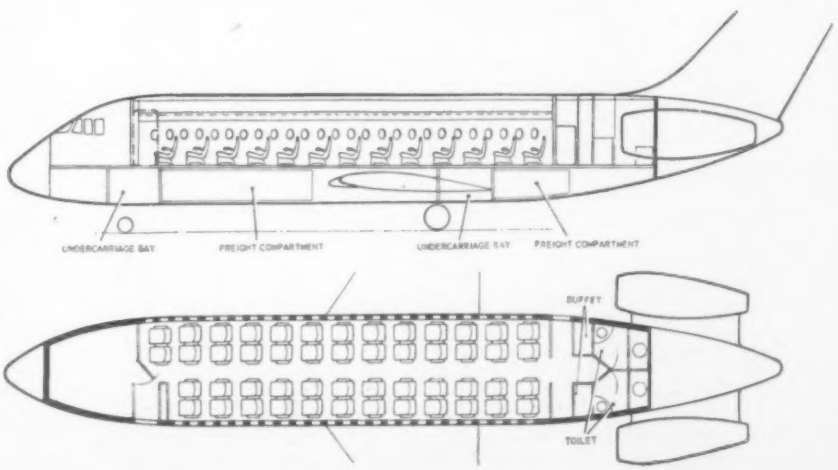
The design philosophy of the BAC-107 calls for a low-first-cost jet airliner (less than £500,000) with payload-range capabilities generally similar to those of the Viscount, Convair 240-440 and Martin 404. The design is based on a fuselage of simple, fail-safe construction accommodating 50-59 passengers and a wing designed for a Mach 0.75 cruise. The wing has a sweepback of 20° and an aspect ratio of 8; with high lift flaps, the max. C_L at landing is approximately 2.30.

Originally, the Hunting 107 was projected with two turbojets. The prospect of fitting Bristol Siddeley BS.75 ducted fans completed the concept of an inexpensive jet airliner, with a fuel consumption per mile flown less than that of the Viscount 700D, while carrying a similar payload at much higher speed. Investigations of alternative BAC-107 designs with higher performance have indicated only small reductions in block time while compromising the whole concept of an inexpensive, simple jet airliner. Direct operating costs of the present design are below 1.2 cents/seat mile at 600 st. miles for the all-tourist version (A.T.A. method)—the lowest D.O.C. claimed for an aeroplane of this class.

Standard seating arrangement is for 50 passengers four abreast at 36-in. pitch, with two windows per seat row. The entrance vestibule is at the front, behind the flight deck, and a buffet and two toilets are at the rear. Using five-abreast seating, up to 59 passengers can be carried. The cabin is pressurized to 7 p.s.i. differential.

The wing employs a tip-to-tip torsion box structure, carrying fuel in integral tanks in the port and starboard mainplane. The centre-section torsion box passes under the cabin floor, and contains the main undercarriage bay, with underfloor baggage holds fore and aft. All controls are fully manually operated. A pneumatic system, supplied at 1,500 p.s.i. by turbo-compressor units using engine-bled air, has been chosen for its low weight and safety, and is used for flap, air brake and undercarriage operation.





BAC-107

Dimensions
- Span: 81 ft. 8 in.
- Overall length: 84 ft. 0 in.
- Overall height: 23 ft. 0 in.
- Gross wing area: 825 sq. ft.
- Sweepback: 20 deg. on quarter chord.
- Internal cabin dimensions:
  - Length (ex. flight deck): 49 ft. 3 in.
  - Max. width: 120 in.
  - Max. height: 77 in.
  - Max. usable floor area (ex. flight deck): 436 sq. ft.
  - Max. usable volume (ex. flight deck): 2,500 cu. ft.

Accommodation
- Normal first-class: 50 (4 abreast).
- Max. coach: 59 (5 abreast).
- Volume of freight and baggage holds: 330 cu. ft. (2).

Powerplants
- Two Bristol Siddeley BS.75 turbofans.
- Take-off power each (I.S.A., s.l.): 7,350 lb.s.t.
- Thrust reversers optional.

Weights and loadings
- Basic operational: 29,000 lb.
- Total fuel: 17,840 lb.
- Mfrs. max. payload: 12,000 lb.
- Max. take-off: 48,500 lb.
- Max. landing: 46,000 lb.
- Max. zero fuel: 41,000 lb.
- Wing loading (max. t-o. wt.): 58.8 lb./sq. ft.
- Wing loading (max. landing wt.): 55.7 lb./sq. ft.
- Power loading (max. t-o. wt.): 3.3 lb./lb.s.t.

Performance
- Design cruising speed (I.S.A.): 440 knots (at altitudes above 25,000 ft. and 44,000 lb.).
- Approach speed (at max. landing wt.): 110 knots.
- Balanced field length (at max. t-o. wt.): At I.S.A. at sea level: 4,750 ft.
- Landing field length required (max. landing wt., I.S.A. at sea level): 5,050 ft.
- Range (take-off to landing), still air, no reserves, I.S.A., max. fuel (2,230 Imp. gal.): 2,500 naut. mi. with 2,000 lb. payload.
- Range (take-off to landing) still air, no reserves, I.S.A., with max. payload: 950 naut. mi.

The layout plan alongside shows the basic BAC-107 arranged for 50 passengers, four-abreast. Since the 107 project was taken over by British Aircraft Corporation, the fuselage diameter has been increased to permit five-abreast high-density seating.

The Avro 771

Report from Farnborough

A RECENT market survey, says A. V. Roe and Co., Ltd., has shown an increasing demand for a short-range twin-jet transport. Consequently, various design studies which the company has made over the past two years or so have been "firmed up" as the Avro 771 project for an aeroplane of this type. A model of the 771 is on show on the Hawker Siddeley stand at Farnborough, and preliminary data for the project have now been published.

As the illustrations show, the Avro 771 closely resembles the British Aircraft Corporation's BAC-107 project (see page 379), which has been under development by the Hunting Aircraft design team for several years. Both designs have clearly been tailored to meet a similar market and in many obvious respects the same formula has been adopted—such as the rear-engined layout, T-tail, large fuselage diameter for five-abreast seating and small close-pitched cabin windows.

The most important difference seems to lie in the wing design. That of the Avro is more highly swept back (30 degrees compared with the 107's 20 degrees) and the published data suggest that the wing is aerodynamically more advanced. It has 12% chord leading edge flaps over 70% of the span and multi-section 30% chord Fowler-type flaps over 64% of the span. These high-lift devices obviously contribute to the very good figure for C_L max. in landing configuration of 2.45—the best claimed for any of the rear-engined, clean-wing transports (see THE AEROPLANE AND ASTRONAUTICS for Aug. 26).

The wing thickness-chord ratio tapers from 11% at the root to 9% at the tip. Aspect ratio is 7.5.

The large-diameter fuselage provides for five-abreast seating of up to 60 passengers. Various other proposed layouts are for 42 passengers four abreast at 36-in. pitch, 16 first- and 30 coach-class passengers or 54 coach-class five-abreast at 34-in. pitch. A small galley is located immediately aft the two-crew flight deck, to starboard opposite the main entry door, and toilets can be located as required fore and/or aft of the cabin.

Under the cabin floor are two baggage holds, fore and aft of the wing torsion box. Equipment bays for radio and radar and aircraft services are also under the floor along the port side. The twin wheels of the main undercarriage legs retract into a bay in the centre section. Undercarriage track is 15 ft., wheelbase 32.75 ft. and Load Classification Number, 22.

Using the A.T.A. formula, and assuming a 2,500-hour utilization, Avro's claim that the 771 has an aircraft/naut. mile cost of 88 pence and a passenger/naut. mile cost (60 passengers) of 1.46 pence. The first cost is expected to be about £450,000.

No decision has been taken to proceed with construction—nor, indeed, does the Avro 771 necessarily represent the Hawker Siddeley Group's final thoughts on the short-haul jet. Other companies in the Group are understood to have similar projects. An important factor in deciding the fate of these projects is likely to be the R.A.F.'s choice of an aeroplane of this kind as a replacement for its Valetta and Varsity navigation trainers.

AVRO 771

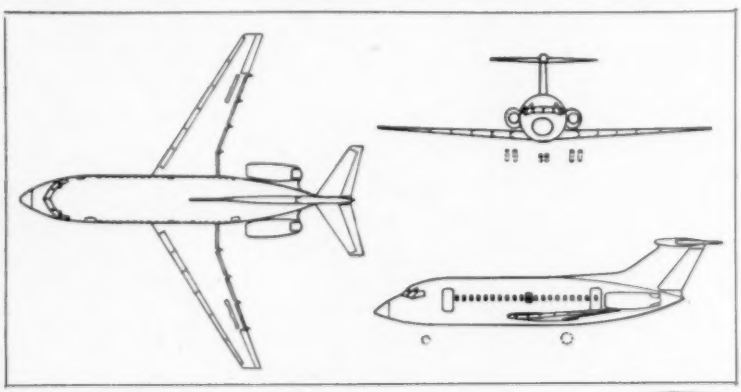
Dimensions
- Span: 77 ft. 5 in.
- Overall length: 80 ft. 4 in.
- Overall height: 24 ft. 3 in.
- Gross wing area: 800 sq. ft.
- Sweepback: 30 deg. at quarter chord.
- Internal cabin dimensions:
  - Length (ex. flight deck): 44 ft. 4 in.
  - Max. width: 119 in.
  - Max. height: 78 in.
  - Max. usable floor area (ex. flight deck): 413 sq. ft.
  - Max. usable volume (ex. flight deck): 2,460 cu. ft.

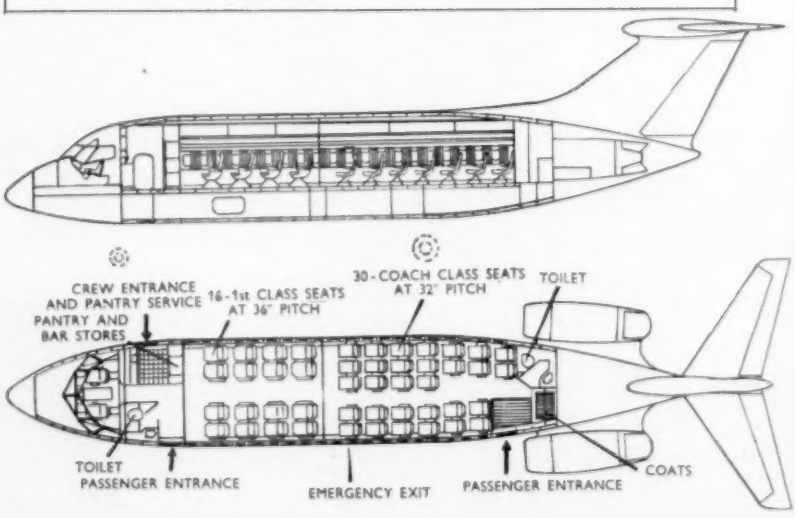
Accommodation
- Normal first-class: 42 (4 abreast, 36-in. pitch).
- Typical mixed class: 16/30 (4 and 5 abreast).
- Max. high density: 60 (5 abreast, 32-in. pitch).
- Volume of under-floor freight and baggage holds: 310 cu. ft. (2).

Powerplants
- Two Bristol Siddeley B.S.75 turbofans.
- Take-off power each (I.S.A., s.l.): 7,350 lb.s.t.
- Provision for water injection and thrust reversers.

Weights and Loadings
- Basic operational: approx. 29,000 lb.
- Total fuel: 16,000 lb.
- Mfrs. max. payload: 12,000 lb.
- Max. take-off: 52,000 lb.
- Max. landing: 50,000 lb.
- Wing loading (max. t-o. wt.): 65.0 lb./sq. ft.
- Wing loading (max. landing wt.): 62.5 lb./sq. ft.
- Power loading (max. t-o. wt.): 3.5 lb./lb.s.t.

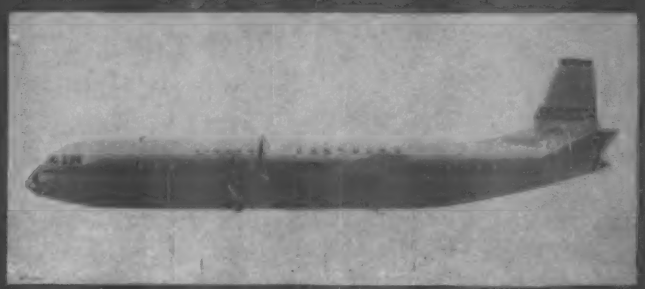
Performance
- Design cruising speed (I.S.A.): 495 knots (at 25,000 ft.).
- Approach speed (at 47,000 lb. wt.): 109 knots.
- Balanced field length (at max. t-o. wt.): At I.S.A. at sea level: 4,800 ft.
- Landing field length (I.S.A. s.l., 47,000 lb.): 4,500 ft.
- Range (still air, I.S.A.), with max. fuel (2,000 Imp. gal.): 1,700 naut. mi.
- Range (still air, I.S.A.), with max. payload: 500 naut. mi.





In the layout drawings, right, a typical mixed-class arrangement is shown, with 16 first-class and 30 coach-class seats.

Wherever British Aircraft



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(Potted biographies on page 382)

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Pilots in the Show

(*Studies by Wren on page* 381)

J. W. Allam.—Deputy chief test pilot, Handley Page, Ltd. Born, 1924. Joined R.A.F.V.R., 1942. E.T.P.S. course, 1950, Boscombe Down, 1951-53. Joined Handley Page, 1954.—**Victor.**

E. R. Anson.—Test pilot, Blackburn Aircraft Ltd. Entered Dartmouth, 1943. Served in Korean and Suez operations. E.T.P.S. course, 1957 and joined Scimitar flight, September, 1959. Loaned to Blackburn, 1959.—**NA39.**

P. Baker.—Test pilot, Handley Page, Ltd. Born, 1925. Joined R.A.F., 1943. E.T.P.S. course, 1953. Boscombe Down, 1954-56. Tutor at E.T.P.S., 1957-59. Joined Handley Page, 1959.—**Victor.**

P. Barlow, D.S.C.—Development test pilot at Christchurch, de Havilland Aircraft Co., Ltd. Born, 1926. Joined R.N., 1942. E.T.P.S. course, 1953. Naval Test Squadron, Boscombe Down, 1954-57. Seconded to de Havilland, 1957. Joined company, 1958—**Sea Vixen.**

R. N. Bates, A.F.C. and Bar.—Squadron Leader, R.A.F. Bomber Command Liaison Officer with Handley Page.—**Victor.**

R. P. Beamont, D.S.O. and Bar, O.B.E., D.F.C. and Bar, D.F.C. (U.S.A.).—Deputy chief test pilot, British Aircraft Corporation. Born, 1920. Joined R.A.F., 1938. Hawker Aircraft, 1941-42 and 1943-44. Gloster Aircraft, 1945. Joined English Electric as chief test pilot, 1947; later, manager flight operations.—**Lightning F.1.**

A. W. Bedford.—Chief test pilot, Hawker Aircraft, Ltd. Born, 1920. Joined R.A.F., 1940. O.C. instrument weather flight, E.T.P.S., 1949. Tutor at E.T.P.S., 1950, and R.A.E test pilot 1950-51. Joined Hawker, 1951.—**Hunter T.66.**

A. Blackman.—Test pilot, A. V. Roe and Co., Ltd. Born, 1928. Joined R.A.F., 1948. E.T.P.S. course, 1954 and later Boscombe Down. Joined Avro 1956.—**Vulcan.**

J. Blair.—Experimental and production test pilot, Scottish Aviation, Ltd. Born, 1916. Joined R.A.F., 1940. Joined Scottish Aviation in 1947.—**Twin Pioneer.**

R. N. R. Bradley.—Assistant chief test pilot, Westland Aircraft, Ltd. Born, 1920. Joined R.N., 1941 and served with F.A.A. until 1946. Chief test pilot, Helliwells, Ltd. Joined Westland, 1950.—**Wessex.**

T. W. Brooke-Smith.—Chief test pilot, Short Brothers and Harland, Ltd. Learnt to fly at 16 and obtained "A" and "B" licences before War. Joined A.T.A., 1941. Entered Shorts, 1942, to open up Stirling Pilots Pool; became an assistant test pilot, and chief test pilot in 1948.—**Short SC.1.**

G. R. Bryce, O.B.E.—Chief test pilot British Aircraft Corporation. Born, 1921. Joined R.A.F., 1939. Joined Vickers-Armstrongs in 1946; chief test pilot, 1951.—**Vanguard.**

J. G. Burns.—Test pilot, Blackburn Aircraft, Ltd. Born, 1928. Joined R.A.F., 1945. E.T.P.S. course, 1954 and then Boscombe Down. Left R.A.F., 1958, and joined Hunting Aircraft, Ltd. Joined Blackburn, 1959.—**NA39.**

W. R. Burton.—Test pilot, Handley Page, Ltd. Entered R.A.F., 1938. Resigned 1939 to become E.F.T.S. instructor. Rejoined R.A.F. at outbreak of War. Joined Handley Page in 1948.—**Dart Herald.**

C. A. Capper.—Chief test pilot, Airspeed Division, de Havilland Aircraft Co., Ltd. Born, 1923. Joined R.A.F., 1942. E.T.P.S. course, 1948. Aero Flight R.A.E., 1949-52. Joined Bristol Aeroplane Co., 1953, and de Havilland later same year.—**Sea Vixen.**

N. J. Capper.—Flight manager and chief test pilot, Scottish Aviation, Ltd. Born, 1907. Served in R.A.F., 1929-34 and 1939-44. Returned to Scottish Aviation, 1945.—**Twin Pioneer.**

J. L. Dell.—Deputy chief test pilot, English Electric Aviation. Spent 17 years in the R.A.F. Gunnery Instructor at Central Gunnery School. No. 43 Squadron, 1949; C.F.E., 1950; posted to the Fighter Weapons School as an instructor, 1954. Fighter Command Liaison Officer with English Electric, January, 1957, to August, 1959.—**Lightning T.4.**

L. de Vigne, A.F.C.—Test pilot, Westland Aircraft, Ltd. Born, 1915. Served with R.A.F., 1940-51. E.T.P.S. course, 1947. R.A.E. Farnborough, 1948-52. Armstrong Siddeley Motors' chief test pilot, 1952. Joined Westland 1953.—**Gnome-Whirlwind.**

H. Else.—Senior test pilot, Sir W. G. Armstrong Whitworth Aircraft, Ltd. Joined R.A.F. at the age of 20. Served in War; later seconded to Boscombe Down. Joined A.W.A. as a test pilot in 1947.—**Argosy.**

E. G. Franklin, D.F.C., A.F.C., A.R.Ae.S.—Chief test pilot, Sir W. G. Armstrong Whitworth Aircraft, Ltd. Born 1920. A.W.A. apprentice, 1937. Joined R.A.F.V.R., 1939. Test pilot with Handley Page and Boscombe Down, 1942. E.T.P.S. course, 1944, and test flying at Boscombe Down. Rejoined A.W.A., 1945.—**Argosy.**

W. R. Gellatly.—Test pilot, Westland Aircraft, Ltd. Born, 1920. Joined R.N.Z.A.F., 1940. E.T.P.S. course, 1950. Helicopter Flight commander, Boscombe Down, 1951-54. Joined Fairey Aviation, 1955; chief helicopter pilot.—**Rotodyne.**

J. G. Harrison, A.F.C.—Chief test pilot, A. V. Roe and Co., Ltd. Born, 1918. Joined R.A.F., 1935; E.T.P.S. course, 1949. Test pilot, R.A.F., 1950-52. Joined Avro, 1954; chief test pilot, 1958.—**Avro 748.**

H. G. Hazelden, D.F.C. and Bar.—Chief test pilot, Handley Page, Ltd. Born, 1915. Joined R.A.F.V.R., 1939. Took No. 1 course at E.T.P.S. at Boscombe Down. C.O. Heavy Aircraft Test Squadron, Boscombe Down, 1945. Joined Handley Page, 1947; appointed chief test pilot same year.—**Dart Herald.**

C. T. D. Hosegood.—Test pilot, Westland Aircraft, Ltd. Born, 1921. Joined R.N., 1939. Helicopter flying training course in U.S.A., 1944. Joined Bristol, 1948; chief helicopter test pilot.—**Belvedere.**

J. K. Isherwood.—Production test pilot and communications pilot, English Electric Aviation, Ltd. Born, 1932. Began flying with R.A.F. in 1952. Joined English Electric, 1956.—**Lightning.**

J. J. M. Jeffrey.—Test pilot, Westland Aircraft, Ltd. Born, 1922. Joined Fleet Air Arm, 1940. Helicopter instructors' course in U.S.A., 1944. Joined Saunders-Roe, 1950.—**Wasp.**

D. M. Knight.—Test pilot, English Electric Aviation, Ltd. Born, 1931. Began flying with R.A.F., 1949. With No. 603 (City of Edinburgh) Sqn., R.Aux.A.F., 1951-54. Joined English Electric, 1953.—**Lightning.**

M. J. Lithgow, O.B.E.—Deputy chief test pilot Vickers-Armstrongs (Aircraft). Fleet Air Arm, 1939-45, then joined the Supermarine Works of Vickers-Armstrongs.—**Vanguard.**

D. Lockspeiser.—Test pilot, Hawker Aircraft, Ltd. Born, 1927. Joined R.A.F. on Short Service Commission, 1949. Released to join Hawker Aircraft, 1955.—**Hunter F.R.10.**

T. D. Lucy, B.A.—Test pilot, Hawker Aircraft, Ltd. Born, 1922. R.A.F., 1941-46. Joined Hawker Siddeley, 1952; became production test pilot, 1953; was chief test pilot at Blackpool.—**Gloster Javelin.**

D. Marthew.—Started gliding in 1948 at Cambridge University Gliding Club. Founder member and C.F.I. of the R.A.E. Gliding Club.—**Slingsby Swallow.**

R. Martin, D.F.C. and Bar, A.F.C.—Chief test pilot, Gloster Aircraft Co., Ltd. Born, 1918. Joined R.A.F., 1937. E.T.P.S. course, 1945. Flight Commander, S.M.E. and Aero Flights, R.A.E., 1947-50. Instructor E.T.P.S., 1950. A.M., 1952-53. Joined Gloster, 1954.—**Javelin**

B. Masters. — Gliding since 1949. Assistant C.F.I. at Lasham since 1956.—**Skylark 3.**

H. G. H. Merewether.—Deputy chief test pilot, Hawker Aircraft, Ltd. Born, 1924. Fleet Air Arm, 1943-46. Joined Hawkers in 1954.—**Hunter T.66A.**

J. G. P. Morton.—Test pilot, Westland Aircraft, Ltd. Born, 1925. Joined R.N., 1943; Boscombe Down, 1952-54. Joined Fairey Aviation, 1955.—**Rotodyne.**

P. Murphy.—Test pilot, Handley Page, Ltd. Born, 1927. Joined R.A.F., 1945 Went to Vickers-Armstrongs, 1951. Joined Handley Page, 1958.—**Victor.**

M. Oliver.—Test pilot, Folland Aircraft, Ltd. Born, 1922. Joined R.A.F., 1939, and R.Aux.A.F., 1947. Joined Folland, 1957.—**Gnat Trainer.**

S. B. Oliver.—Chief test pilot, Hunting Aircraft, Ltd. Born, 1924. Joined R.A.F., 1942; transferred to R.N., 1945. E.T.P.S. course, 1950. Naval Test Squadron, Boscombe Down, 1951-52. Joined Hunting Aircraft, 1954.—**Jet Provost 4.**

J. R. S. Overbury.—Test pilot, Hunting Aircraft, Ltd. Born, 1925. Joined R.N., 1943. E.T.P.S. course, 1953. Naval Test Squadron, Boscombe Down, 1954-56. Joined Saunders-Roe, 1956. Joined Hunting Aircraft, 1959.—**Jet Provost 4.**

G. R. I. Parker, D.F.C. and Bar, A.F.C., D.S.M.—Experimental test pilot, Blackburn Aircraft, Ltd. Born, 1918. Joined R.A.F., 1934. Test pilot at R.A.E., 1945. Joined General Aircraft in 1948.—**NA39.**

H. Phillips.—Test pilot, Westland Aircraft, Ltd. Born, 1918. Joined R.N., 1934. Helicopter flying course, 1949. Helicopter test pilot, Boscombe Down, 1955-58. Joined Saunders-Roe, 1958.—**Skeeter.**

(*Continued on page 388*)

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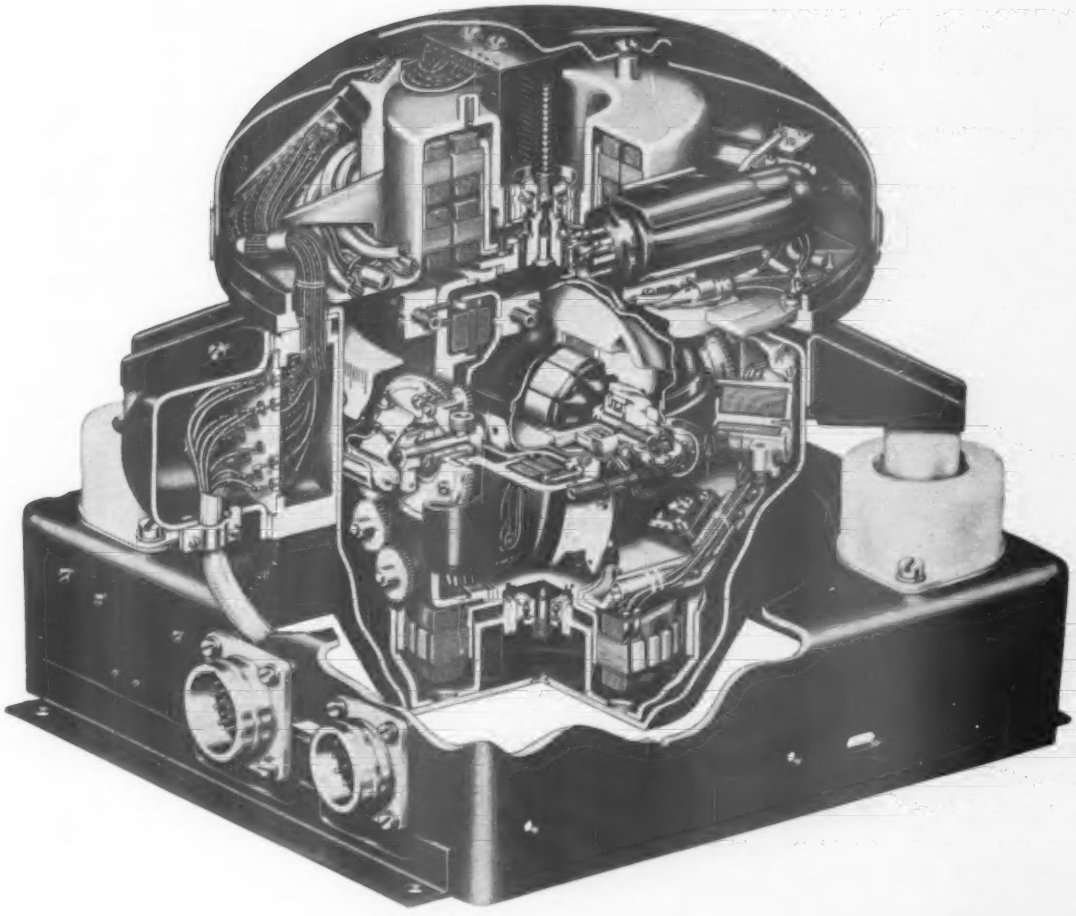

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"Well done, Auster Aircraft Ltd. You have certainly taken a long time to get round to it, but you have produced something on which (if he had any) the writer would stake his money . . . "

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Col. C.R. Battle Jnr., General Thomas White and Col. C. Mathison, who recovered the capsule.

Irvin chutes make history again

The instrument capsule ejected from the American Discoverer XIII satellite on 12th August was brought down safely near Hawaii. Its descent after re-entry into the atmosphere was controlled by parachutes specially designed and manufactured by Irving Air Chute Co. in conjunction with Lockheed Aircraft Co. and General Electric Co.

A week later, on 19th August, the instrument capsule from Discoverer XIV was brought down, again by Irvin parachute, and recovered in the air by a C-119 aircraft.

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ENGINE-TEST AREA.—Three test stands here include the one in the foreground which is now used for tests of the complete Blue Streak and its systems. Other photographs of Spadeadam are on page 341.

Spadeadam on View

VISITING the Spadeadam Rocket Establishment is very much like seeing the Rocketdyne engine test facilities at Santa Susana in California and the Atlas launch pads at Cape Canaveral put together in one location. The Spadeadam engine-test stands have in fact been modelled on those of Rocketdyne and the Blue Streak check-out and static-firing facilities there have drawn heavily on Atlas experience, as indeed has the Blue Streak missile itself.

Spadeadam is high on the Cumberland Fells 20 miles north-east of Carlisle. Its facilities lie within 10,000 acres of remote hills and bog land. The establishment was set up solely for the development and static test-firing of rocket engines for the Blue Streak long-range ballistic missile and for check-out tests of the complete missile and all its systems.

Since 1955 the extensive facilities at Spadeadam have been built in an area which was formerly desolate and unused. Launch pads have been installed which are identical to those built for Blue Streak firings at Woomera. It was intended that all Blue Streaks, both development and production missiles, should be fully checked out and test-fired at Spadeadam before dispatch to their launching sites.

The establishment is divided into five areas, which are widely separated for safety reasons. These are an administrative and workshop area, a plant for the production of liquid oxygen, and three areas for the static testing of rocket engine components, of complete engines and of complete missiles respectively.

Today most of these test facilities are structurally complete and many are in use. But since the cancellation of the Blue Streak missile programme last April, no further building work or installation of equipment has been done. Nevertheless development tests of rocket engines and complete missiles are being continued, although at a lower priority than in the past.

The comprehensiveness of the Spadeadam facilities is very impressive. It is not surprising that the latest estimate for the cost of completing the establishment approaches £25 million—more than double the original estimate. Considering the nature of the facilities, their wide scope and extensive instrumentation, a visitor from the United States would probably consider they were a bargain at the price. Novel construction work at such a remote and difficult site has inevitably added to the cost of building the establishment.

The Spadeadam project was initiated in 1955; and in 1956 its construction was begun by the Ministry of Works as agent for the Ministry of Supply. The M.o.S. gave the broad requirements, stipulating the number of test stands needed and the extent of the safety zone for each. A programme was drawn up so that the different facilities would be completed in sequence at dates fitting in with the main Blue Streak programme.

In December, 1956, the main contract for building the establishment was given to a consortium of British Oxygen, Ltd., and Wimpey, Ltd. There was extensive sub-contracting for specialist services, two of the largest sub-contracts going to British Oxygen Engineering, Ltd., for oxygen plant and "low-temperature engineering," and to Pye, Ltd., for instrumentation.

Most of the construction work was done between January, 1957, and January, 1960. The only access to the site was by forestry road; services, roads, electricity and water had to be laid or brought to the site. High-pressure nitrogen and effluent services had also to be provided; extreme care is taken to ensure that no kerosene-polluted water is allowed to enter the local stream. The peak labour force was about 2,000.

Engine fitting shops were commissioned in the winter of 1958-59 and the first test run of a Rolls-Royce rocket engine at the site was in mid-1959.

The establishment is managed on behalf of the Ministry of Aviation by Rolls-Royce, who are responsible for overall supervision, services and maintenance. Tests on missiles and rocket engines are made by de Havilland Propellers and Rolls-Royce respectively. The liquid-oxygen plant is operated by British Oxygen Gases, Ltd., for the M.o.A. At present the total Spadeadam staff employed by the three companies is about 600; Rolls-Royce have found work in other areas for 200 personnel who have become redundant at Spadeadam since the Blue Streak cancellation.

Facilities

Near the entrance to the establishment are the administration area and laboratories, assembly and maintenance workshops for the engines and missiles.

In the engine shops the Rolls-Royce RZ.2 rocket engines for Blue Streak are assembled from components received from Derby, Barnoldswick, Hucknall and Shrewsbury. Two of these liquid-oxygen/kerosene rocket units power each missile. This engine, and the earlier RZ.1, were developed by Rolls-Royce; they are based on the Rocketdyne S.3 family. Rolls-Royce designed the gas generator and turbopump, drawing on Rocketdyne experience.

After assembly engines are tested individually and then as a power pack of two engines. No thrust figure is available for the RZ.2, but an earlier engine, presumably the RZ.1, develops

approximately 135,000 lb. thrust, so the total thrust available for Blue Streak is probably above 270,000 lb. The RZ.1 was run at Westcott before the first test-firings at Spadeadam.

In the de Havilland shop the missiles are given an initial check-out after arrival from Hatfield. There are three check-out bays, but there was only one missile there during our visit. As mentioned in THE AEROPLANE AND ASTRONAUTICS for Jne. 10, the missile structure is of welded stainless steel sheet, stiffened by external stringers over the kerosene tank and guidance bay and nose sections. During transit it must be pressurized to maintain structural stiffness or kept under a tensile load of 16,000 lb., which is applied by hydraulic jacks.

Some distance from the administration and workshop area is the liquid-oxygen plant. This contains two standard commercial plants, each capable of producing daily 50 tons of liquid oxygen, 60 tons of gaseous nitrogen and 8 tons of liquid nitrogen. At present one plant is shut down and the other is operated 24 hours a day, seven days a week; its output is above the current needs of the establishment and surplus liquid oxygen is sold commercially.

A range of facilities is available at the engine component test area where sub-assemblies can be calibrated and tested. Nine individual concrete test cells are arranged round a central blockhouse from which all tests are observed and in which all instrumentation readings are recorded. Closed-circuit television and periscopes are used to observe tests.

Three of the cells are for gas-generator tests; they were used at one time but are now "moth-balled." There are also two stands for turbopump tests; these are modelled on Rocketdyne practice and one was in use during our visit. A pump development section was being built with two RA.7 Avons to provide shaft power—7,000 b.h.p. for each—for pump tests; it remains incomplete.

In a separate building on this site is a high-flow water test plant, which is 95% complete. It could be used for flow tests on flowmeters, injectors and regeneratively-cooled thrust chambers; two pumps can supply either 6,000 gal./min. at 200 p.s.i. or 3,000 gal./min. at 600 p.s.i. The water is recirculated.

Distances of up to 1¼ miles separate the different test areas. In the engine test area there are four stands. Each is a large concrete and steel structure in which the engines are mounted to fire vertically down into a water-cooled deflector which directs the exhaust flame horizontally. During firing 24,000 gal./min. of water is sprayed into the exhaust bucket.

Two of the stands are similar, one being used to test single engines and the other for power packs of two engines together. The third stand is being used for missile system tests, with a complete Blue Streak mounted in it. This was planned as a temporary measure pending completion of the launch pads at the missile test site. But following the Blue Streak cancellation, these are not being completed, and missile check out, compatibility and ground-running tests are being made in this engine stand.

The fourth stand, which remains incomplete, is a smaller one of concrete construction. It is of more advanced design than the others and only half as expensive, although capable of the same duty. In this design liquid oxygen and kerosene tanks were to be spherical and mounted on the sides rather than above the stand, as in the case of the others.

There is one control blockhouse with recording instrumentation which is used for all engine test stands. It is 600 ft. from the nearest stand and built of 2-ft. thick reinforced concrete. It has 130 chart-type recording instruments, four 24-channel oscillographs and, when fully equipped, eight control consoles.

Information on up to 100 aspects of engine performance and operation can be recorded simultaneously. During firings the test stands can be viewed through a periscope and by closed-circuit television; firings are also recorded by cine cameras.

Development tests are made on the single-engine stand. Production engines are also tested on this stand for performance and so that their thrust can be accurately aligned using slides on their swivel gimbals.

During our visit a test firing was made in the two-engine stand. Unfortunately the firing was shut down prematurely because fuel-pump pressure did not reach the required value. There had been only two premature shut-downs in 30 earlier test runs on this stand.

The third major test area is for complete missiles. This has two missile test stands, each with a moving service tower. On these stands, which are representative of the launch pads at Woomera, it was intended that missiles should be statically tested, including firing of their engines. In fact, the stands are structurally complete but lack much of their instrumentation, and, as already mentioned, missile tests are now being made at a stand in the engine test area. For static tests missiles are mounted on a launch platform built by Morfax, Ltd., of Mitcham, as shown in the special sketches on page 385.

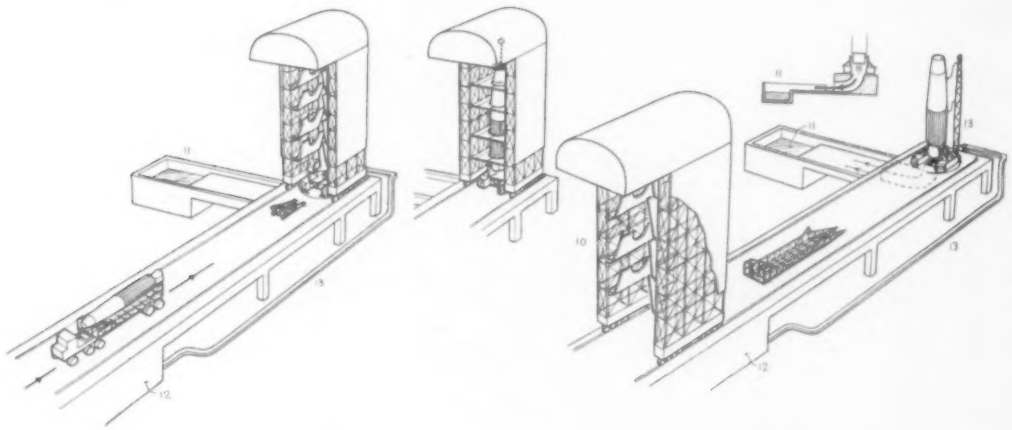
The two missile stands are fully instrumented and remotely controlled from a central blockhouse which is 1,000 ft. from each stand. As with engine and component tests, the missile tests were to have been controlled from this blockhouse and extensive instrumentation was to have been installed to monitor and record test results.

Three launch pads similar to these test stands were to have been built at Woomera for development firings of Blue Streak. One of these has been completed.

As a whole, Spadeadam is an impressive and highly specialized establishment which depends for its existence on the Blue Streak missile. Many of its facilities are in use, all could probably have been completed in six months. At present it is largely in a state of suspended animation; its fate will be decided by the Government decision whether or not Blue Streak should be used as a space launcher.

If this happens the facilities will have a vital part to play. But even then they cannot be used to the full, as Spadeadam was intended for tests of all production Blue Streaks. These would have been built in far greater numbers as missiles than will be the case when they are used as satellite vehicles. Nevertheless, the Spadeadam facilities represent a considerable achievement and it is a sobering thought that they are on the whole inflexible and unlikely ever to be used to their full capacity.—J. R. COWNIE.

ENGINE TESTS.—Based on Rocketdyne practice, this test stand is used for rocket engine firings. The rocket efflux is turned through 90° by a watercooled deflector; during a firing a water flow of 24,000 gal./min. is used.



Test Facilities for Blue Streak

Engine (rocket motor) is tested and joined to body; then transported to tower. Assemble link-frame and guides to slide rocket on to release gear. Mount the rocket and suspend from winch. Drop drawbridge inspection platforms. Rotate base to orientate rocket. Clamp base and remove guides and link-frame again. After checks gantry is removed as 10. All count-down procedures can be followed and engine run with missile anchored. Rocket efflux passes down and along path to precipitate into water-pond 11. Control room (12); lines to service-mast (13).

Drawings by J. H. Clark, A.R.Ae.S.,

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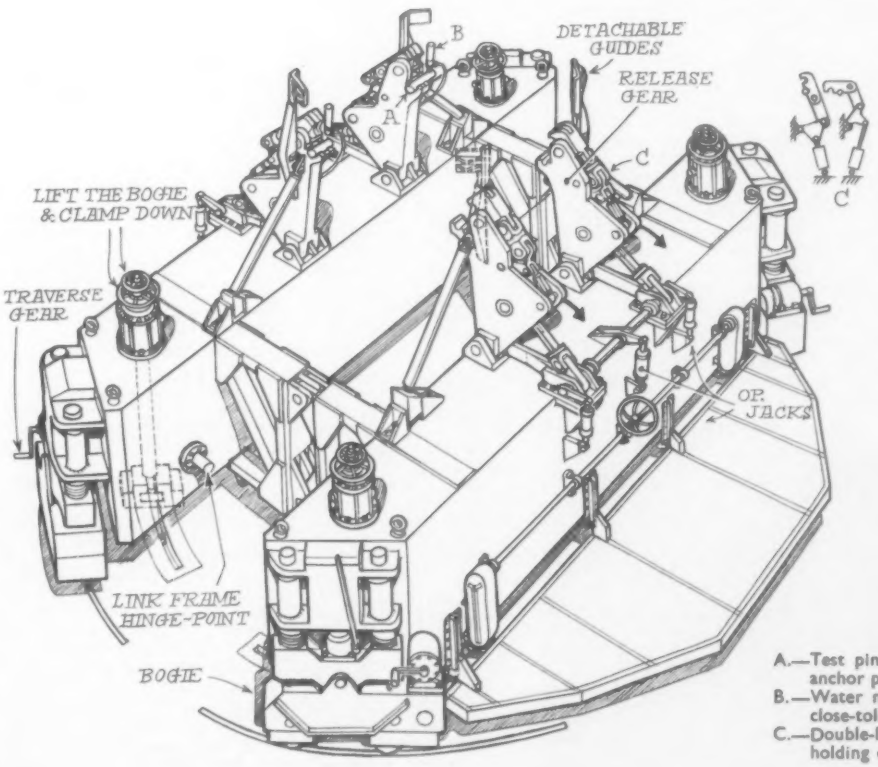

Key

A.—Test pin to simulate rocker anchor pin.

B.—Water micrometer to check close-tolerance levels.

C.—Double-link actuation for holding down claw on pin A.

Probes to Mars

The planet Mars will be favourably placed for the launching of probe vehicles towards it this autumn.

S. W. GREENWOOD, M.ENG., A.M.I.MECH.E., A.F.R.AE.S., *examines the prospects.*

MAN is, and has always been, a space traveller. Every second of time that passes carries him 18½ miles farther round the almost circular path that is the Earth's orbit round the Sun.

Outside the orbit of Earth—at an average distance of just over half as far again as that of the Earth from the Sun—the planet Mars traces out a similar path at lower speed. We are now entering a period during which we are catching up with Mars and about to overtake the planet on the inside. This period is eminently suitable for launching probes to intercept Mars in its orbit and it will be surprising if both the Soviet Union and the United States do not undertake such experiments.

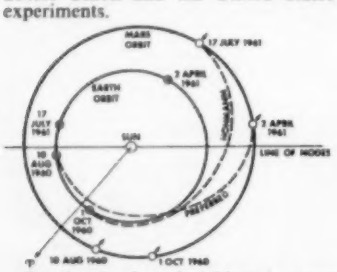

Fig. 1. Orbits of Earth and Mars, and alternative transfer orbits (from Ref. 3).

Despite the fact that Mars is a near-neighbour in space, we possess little detailed information about it. We know, of course, that it is smaller than the Earth with only just over half its diameter, and also that it is less dense, having a surface gravity of a little over one-third of our planet. That it possesses an extensive atmosphere of low density is also well established.

However, these simple facts are sufficient to indicate that Mars would be a favourable objective from the astronautical point of view. In comparison with Venus, for example, it should be easier to enter its atmosphere, to escape from its surface, and also to establish satellites around it.

In two respects, the planet is similar to the Earth. It has a rotational period of 24 hr. 37 min., only slightly more than our own. The planet's axis of rotation is inclined at an angle of 24° to the plane of the orbit, only ½° more than the Earth's.

Naturally, Mars is cooler than the Earth because it lies farther from the Sun. Its surface can usually be observed with telescopes although occasional haze and "cloud" obscures portions of it; and it has a generally ruddy appearance which has given it the name of the Red Planet.

Colour changes on the Martian surface, and the possible nature of the surface markings (which it is impossible to resolve adequately with telescopes) have been a source of considerable speculation, particularly in so far as they may involve the existence of life on the planet. There has even been conjecture that the planet's two small moons of only a few miles diameter may be artificial satellites! However that may be, Mars is of considerable interest as a target for astronautical endeavour and it is difficult to visualize a single branch of science that would not be affected by a study of a world in which conditions for life as we know it appear to be so marginal.

MARS PROBE.—Scientists of the Massachusetts Institute of Technology examine a model of a self-navigating Mars probe which was the subject of a recent feasibility study (see Ref. 2).

NASA has already outlined the nature of the information it intends to obtain from Mars probes (Ref. 1). It will presumably be a progressive programme, in which results from each probe are carefully analysed before proceeding to the next, more ambitious, experiment.

The Administration has listed the following objectives: (1) Atmospheric constituents, pressures and densities, structure, changes in transparency, dynamic features. (2) The planetary ionosphere (if present). (3) Interaction of energetic particles with the planet's atmosphere and fields. (4) Electric, magnetic and gravitational fields. (5) Planet's structure and surface features. (6) Extraterrestrial life (if present). (7) Conditions in region of transfer orbit.

Two probes were launched early last year into orbits lying between those of the Earth and Mars. These were the Russian Lunik I and the American Pioneer IV. They carried instrumentation for obtaining data on radiation and meteorites during flight, and also for obtaining lunar data; but their transmitters ceased to function shortly after the Moon was passed. The American probe, Pioneer V, now in orbit within the Earth's orbit, transmitted data on flight conditions over more than 20 million miles with the help of solar batteries. At the time of writing no true Martian probe has yet been launched, but the capability exists, and the realization is imminent.

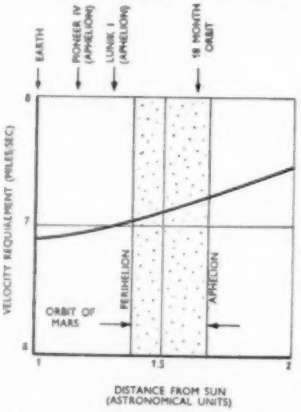

Fig. 2. Velocity requirement for Hohmann orbits.

A recent study by M.I.T. reported in THE AEROPLANE AND ASTRONAUTICS (Ref. 2) considers the problems of placing a 10-lb. camera close to Mars in order to obtain a high resolution photograph, followed by recovery of the camera on the Earth's surface. In practice, it is unlikely that a single experiment of this nature would justify the effort involved, and more varied information would be sought from the probe.

Orbits and Control

The orbits of Earth and Mars are shown in Fig. 1. The ellipticity of the Martian orbit is quite pronounced, and causes the distance between the orbits to vary as indicated. In addition, the two orbits are inclined to one another at an angle of just under two degrees, the line of intersection of the orbital planes being the line of nodes.

This inclination may seem small, but it has an important effect on the vehicle velocity requirements for transfer between the two planets, and on the journey times. This is because all the velocity needed for departure from the ecliptic, the Earth's orbital plane, must be provided by the vehicle.

In the simple two-dimensional case, ignoring the inclination of the planetary orbits, the transfer orbits permitting maximum distance travelled relative to the Sun are elliptic orbits tangential to the Earth's orbit. These orbits—known as Hohmann orbits—are associated with velocity requirements for the Earth-Mars region, of the magnitude given in Fig. 2.

Taking the Earth escape velocity as 6.9 miles/sec., it is seen

(*Continued on page 387*)

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Avro's latest triumph, the 748, represents the climax of intensive effort developing a successor to that veteran jack-of-all-trades, the DC-3. The Avro 748 is robust, simple and cheap to operate. It offers a level of performance and passenger comfort never achieved in any similar aircraft. Capable of operating under the most difficult conditions to be found in any world market, the 748 carries payloads of 44 passengers, or 10,990 lbs. freight. Cruises at 230 knots high above the weather in smooth, pressurised comfort. New minds, new materials and traditional Hawker Siddeley experience and know-how have made the Avro 748 possible.

'. . . . the cheapest aircraft of its kind on the market'—
The Aeroplane, Sept. 11, 1959.

Two Rolls-Royce Dart Engines

Take-off in 2,520 feet
Wide track undercarriage
Low-pressure tyres
High-efficiency flaps

} Operates with ease from high-altitude short and unprepared airstrips.

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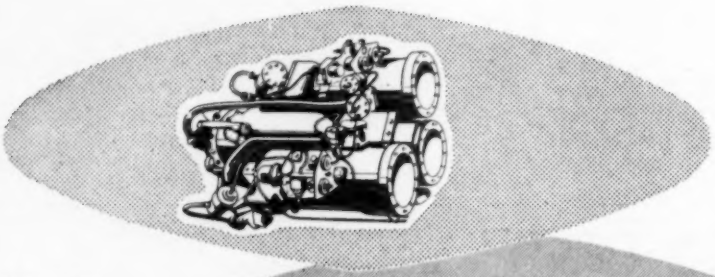
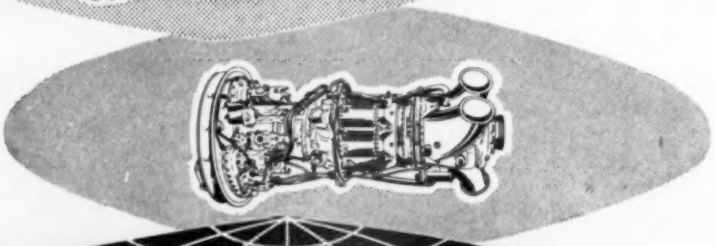


TRIPLE SCORPION an aircraft rocket engine which provides a source of extra power at all altitudes. Designed for sustained firing and long operational life.

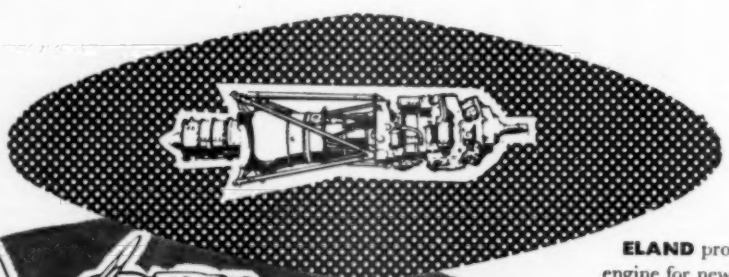
GAZELLE free turbine engine (1650 s.h.p.) powers the Westland Wessex and the Type 192. Now chosen to power the twin-engined Wiltshire.

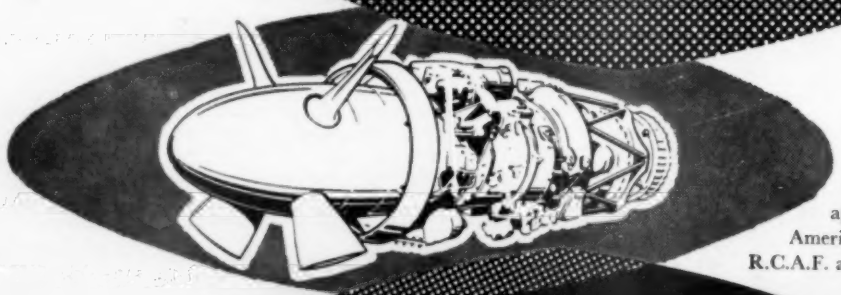


NAPIER AERO ENGINES

for the world

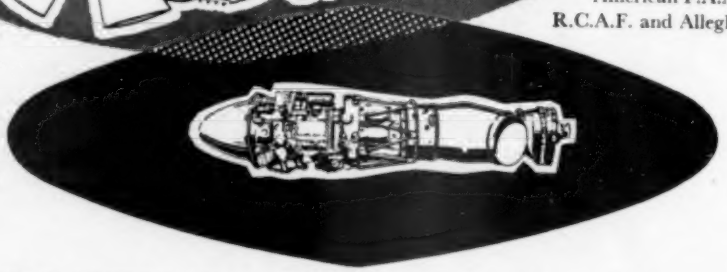
ELAND engines designed for the Rotodyne are basically the standard Eland with an auxiliary compressor mounted at the rear.





ELAND propeller-turbine engine for new airliners and for the conversion of piston engined airliners. The Eland which powers the Canadair 540 and Convair 540, is rated at 3,500 e.h.p. and is approved by British A.R.B. and American F.A.A. In service with the R.C.A.F. and Allegheny Airliners U.S.A.

ELAND engines for the Westminster are installed horizontally on top of the fuselage with a mechanical drive to the rotor shaft.



D. NAPIER & SON LIMITED, LONDON, W3 MEMBER OF THE ENGLISH ELECTRIC GROUP

(*Continued from page 386*)

that the velocity requirement for reaching Mars at no time exceeds 7.25 miles/sec. This will have a small influence on the payload that can be transported. Fig. 2 also shows the distance relative to the Sun reached by the two probes already launched in this region.

For return to the neighbourhood of the Earth, it is desirable to make the elliptic orbit have a duration which is a suitable subdivision of a whole number of years, so that after two or more complete revolutions of the Sun it may meet up with the Earth again. The 18-month orbit appears particularly attractive for this purpose, as it reaches approximately to the limits of the Martian orbit.

The objections to Hohmann orbits are discussed in Ref. 3. From the control viewpoint, the acceptable tolerance on launch velocity is extremely small—of the order of a few tenths of a foot per second. The authors of Ref. 3 express strong preference for a transfer orbit permitting relative insensitivity to errors in launch velocity.

Such a "preferred" orbit is compared with a Hohmann orbit in Fig. 1. The velocity requirement of 7.3 miles/sec. is higher than the Hohmann requirement of 6.9 miles/sec., but the advantages justify the increase. The "preferred" orbit also allows for uncertainty in the magnitude of the Astronomical Unit.

Full allowance for the effects of inclination of the planetary orbits was made in the preparation of the data given in Fig. 3. From this it is possible to compare velocity requirements with

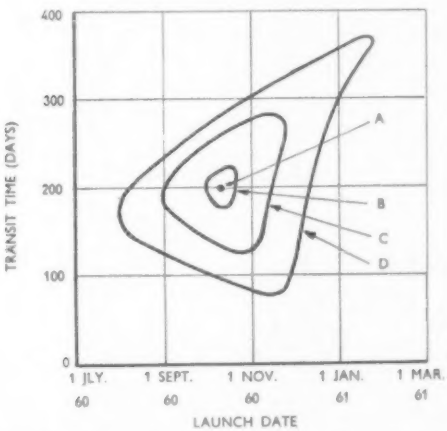


Fig. 3. Effect of launch velocity on Earth Mars transfer orbits (adapted from Ref. 3), A: 37,000 ft./sec. (7.01 miles/sec.), B: 37,500 ft./sec. (7.11 miles/sec.), C: 40,000 ft./sec. (7.58 miles/sec.) D: 50,000 ft./sec. (9.48 miles/sec.).

launch dates for the present propitious period of Mars-probe launchings. The region of the diagram of practical interest is that lying below the line for a transit time of 200 days.

It is seen that the launching period available widens as the available vehicle velocity increases. Fig. 4 has been plotted from Fig. 3 to illustrate this point. The lowest velocity requirement occurs at or near Oct. 10, 1960, and launches earlier or later than this date involve higher velocities and therefore, for a given vehicle, smaller payloads.

The velocity requirement for a launch in the early part of September is about 7.5 miles/sec., and the launching period permitted with this capability is about two and a half months, running well into November.

An advantage of high-energy, as opposed to Hohmann, orbits is that the distance separating the two planets when the probe approaches the target is reduced. The separation for the "preferred" orbit in Fig. 1 is about 1.3 Astronomical Units, whereas that for the Hohmann orbit is over 2 Astronomical Units. This will ease the data transmission problem for the high-energy orbit.

Several independent studies of the control problem have indicated that an approach to about 10,000 miles from Mars should be ensured if the probe carries a reliable navigation system sighting on the Sun and the star field, and corrections are applied early in the flight by a small rocket having a velocity capability of a few hundred feet per second.

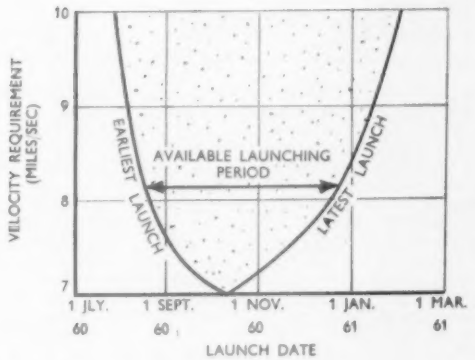


Fig. 4. Dependence of launching period on vehicle performance.

A fairly sophisticated navigation and control system is described in Ref. 2. It is interesting to note that this study uses a transfer orbit that is substantially the 18-month orbit travelled twice, although the duration of the mission works out at 3.2 years rather than 3 years owing to the perturbing effect of a close approach to Mars, and other factors.

Vehicles and Payloads

Guessing the ability of a nation to launch a given payload is an art mastered by few. Developments in structural design techniques, propellent performance, and vehicle size can confound the most optimistic prophet. It is a curious phenomenon that the astronautical societies of the West have been noticeably in error on the conservative side in the past in estimating the pace of astronautical progress in general and Russian achievements in particular.

In terms of proved performance, we have Lunik I reaching out almost as far as Mars with a payload of 800 lb. Pioneer IV journeys almost as far with a payload of 13.5 lb. It must be remembered, however, that Pioneer V, travelling within the Earth's orbit under similarly severe conditions, carries a payload of nearly 100 lb.

Where the velocity requirement is at its lowest, in mid-October, the Russians should be able to launch at least half a ton to Mars, and the Americans between one hundred and several hundred pounds, depending on whether Thor or Atlas is used as the booster stage. It is important to realize that these payloads are sufficient for preliminary research during a close pass. The Russian capability is particularly enviable, and is not likely to be matched until Centaur is available, possibly in time for the next favourable launch period in just over two years' time.

Should attempts be made to launch towards Mars in the immediate future, the penalty in terms of velocity requirement has already been demonstrated in Fig. 4. It may be desirable to launch early in the available period in order to gain experience on vehicle and payload behaviour that could be applied to a second probe launched a little later. For this reason, limitation on the size of the first payload may be accepted.

A second reason, not necessarily the less important, is that it might be deemed advantageous to launch earlier for propaganda purposes. The payloads possible are in the order of at least a few hundred pounds for the Russians, and of tens of pounds for the Americans, on the basis of proved performance to date. The extremely comfortable position of the Russians in this respect is evident. They should be able to launch a fully instrumented and controllable probe, whereas the Americans will probably have to be content to explore conditions on the journey.

However, since the Americans "got wise" to the propaganda value of significant achievements in astronautics, it is possible that they may make a special effort. Suitable Earth-Mars flights will not again be possible until late 1962. The present period should see some determined effort to get preliminary experience.

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1. "The NASA Space Sciences Programme," *Astronautics*, July, 1959.

2. "A Self-navigating Space-probe," THE AEROPLANE AND ASTRONAUTICS, Jly. 8, 1960.

3. R. J. Gunkel, D. N. Lascody and D. S. Merrilees, "Impulsive Midcourse Correction of an Interplanetary Transfer." Paper presented at 10th I.A.F. Congress, London, 1959.

Gliding Notes

by Dr. A. E. Slater

ON arrival at Stockholm for the Astronautical Congress I was met by Olle Berg, taken to his flat, given a hearty breakfast by Mrs. Berg and driven out to the Stockholm Gliding Club, which is in the nearest bit of open country at Skarpnäck to the south-east, only 5 miles from the city centre. The ground has three runways and is part of a sports area owned by the Stockholm Board of Athletics, so that other sports are carried on alongside—but I forgot to ask if anyone ever changed his sport as a result of seeing the gliders pass over.

A Piper Super Cub does the launching at a climbing rate of 5 m./sec. In the same hangar with it are two Grunaus (one 22 years old), an Olympia-Meise, a Moswey 3 bought from Switzerland in 1946, mushrooms growing on the floor, and a Butzweiler road sign as a souvenir of the World Championships. A second hangar contains two Bergfalke two-seaters, a Ka-6, a home-built Fauvel AV-36 flying wing, and a Meise built by a pilot in his kitchen while recovering from a Kranich crash nine years ago in which he lost a leg.

The take-off run from Bromma airport on the opposite side of the city often crosses the gliding field, but restrictions are reduced to a minimum by the fortunate circumstance that the Director of the Air Traffic Bureau of the Ministry of Civil Aviation, Mr. Karlsson, is a Gold "C" pilot; he was Swedish team manager at the 1952 World Championships.

Club members are bothered by the sea breeze only in April, May and June; in July and August they get thermals even in east winds off the sea. The best cross-country wind is N.N.E., which carries them overland away from the biggest lakes. Just over Silver "C" distance in this direction is the Södertalje Gliding Club.

Half a year ago, Mr. Berg said, the Swedish Government stopped their gliding subsidy, but soon afterwards renewed it in the form of a 50% contribution to the total cost of training young people of 15 to 21 years. The pupil's contribution to the cost of training up to the "C" stage is equivalent to £15 or £20. But very few continue to fly gliders after that; other interests draw them away.

It is some years since gliding formed an official part of the Swedish Air Force's activities, and in order to keep the single remaining Air Force gliding school at Ljungbyshed going a club had to be formed to take over ownership of the gliders. Per Axel Persson, the 1948 World Champion, is chief instructor there.

Like the Stockholm Club, all Swedish gliding clubs are going over from winch-launching to training by aero-tow, and are acquiring Bergfalkes for dual training. Each pupil will have 20 to 25 flights in these before doing 10 solos on either a Grunau Baby or another Bergfalke, so that he will have had eight hours in the air before being allowed to try for his "C"—a very different routine from the old days of solo training when total flying time to the "C" stage could be counted in minutes.

* * *

Consequently a lot of T-21s, which were the most suitable trainers for winch-launching, are being disposed of, and some have been coming to Great Britain. In July Bengt Mikrander and two friends looked in on the London Club after having towed a T-21 by air all the way from Gothenburg to Lympne, with stops at Malmö, Kiel, Wilhelmshaven, Hilversum and Ostend. The original tug broke down after the first leg, so they then hired a Piper Super Cub from Denmark. Total flying time, 13 hr. 45 min. against the wind, was spread over four days. The machine had been bought by a new club in the Leicester district which has given itself the same name as the East Midlands Gliding Club already founded by the R.A.F.

The same Swedish party later towed another T-21 to Scotland for the new Glasgow and West of Scotland Gliding Club.

Swedish gliding people run a decentralized contest with annual prizes. Last year Olle Berg won the altitude prize for three climbs totalling 14,400 metres, which means an average of nearly 16,000 ft. per flight. The distance and speed prizes are each for one flight only, but there are also prizes for clubs which produce the best aggregate of 10 flights in each category. Flights in the national contest do not count.

* * *

SUTTON BANK'S local distance record was broken twice in August. First Chris Riddell made 95 miles to Grantham, and then Doug Collinson flew his Skylark 2 to Bury St. Edmunds, 160 miles. So far as I can remember, the previous record from the Yorkshire Club was 55 miles to Withernsea by John Neilan during the 1935 national contest.

Several high flights in cu-nims were made from the Bristol Club on Aug. 7. Derek Stowe reached 24,500 ft. in his Skylark 2, Bob Perrott made 19,500 ft. and earned a second Diamond; Peter Collier reached 14,000 ft. and Alwyn Sutcliffe, Ted Childs and Tim Bradbury 13,000 ft. each, the last in an Olympia. John Cochrane reached 13,000 ft. the previous week-end, and Peter Collier made a goal flight of 192 miles northwards to Speeton on the Yorkshire coast just beyond Flamborough Head.

Pilots in the Show . . . .

(Continued from page 382)

D. Piggott.—C.F.I. at Lasham Gliding Centre. Ex-C.F.S. Instructor; C.F.I. at A.T.C. Gliding Instructors' School at Detling.—**Elliotts 460.**

R. Procter.—Deputy C.F.I. of R.A.E. Gliding Club. Started gliding at school in 1947; Army Gliding Club, 1951; joined R.A.F., 1956.—**Elliot Olympia 2b.**

H. W. Rayner.—Test pilot, Handley Page, Ltd. Born, 1929. Joined Rhodesian Air Training Group, 1948. Joined No. 92 Squadron, R.A.F., 1950. Brookland Aviation, Northampton, 1954; Armstrong Siddeley Motors, Bitteswell, 1955. Joined Handley Page, 1960.—**Victor.**

K. M. Reed.—Test pilot, Westland Aircraft, Ltd. Born 1921. Joined R.N. Helicopter Squadron, 1945. Joined Westland Aircraft, 1949. Joined Saunders-Roe in 1952; chief helicopter test pilot in 1958.—**Gnome-Wasp.**

R. N. Rumbelow.—Test pilot, Hunting Aircraft, Ltd. Born, 1930. Joined R.A.F., 1951. Joined Hunting Aircraft, 1957.—**Jet Provost 4.**

K. Rutter.—Chief test pilot, Lancashire Aircraft Co., Ltd. Was in the Czechoslovakian Air Force; joined Lancashire in 1959.—**Prospector.**

W. H. Sear.—Chief test pilot, Westland Aircraft, Ltd. Born, 1923. Joined R.A.F., 1942; transferred to F.A.A., 1945. E.T.P.S. course, 1951, and went to Boscombe Down. Seconded to Westland, 1953; chief test pilot in 1955.—**Westminster.**

C. W. Simpson.—Test pilot, Sir W. G. Armstrong Whitworth Aircraft, Ltd. Born, 1924. Joined R.A.F., 1942, transferred to R.N. in 1946. Technician with Bristol Aero-Engines, 1948-1950. Rejoined R.A.F., 1950. Joined A.W.A. 1958 from Boscombe Down.—**Argosy.**

D. M. S. Simpson.—Test pilot, Hawker Aircraft, Ltd. Born, 1927. Joined R.A.F. on Short Service Commission, 1949. Joined Hawker Aircraft, 1954.—**Hunter F.R.10.**

E. A. Tennant.—Chief test pilot, Folland Aircraft, Ltd. Born, 1922. Qualified as R.A.F. pilot, 1941. E.T.P.S. course; Boscombe Down, 1950. Joined Folland, 1953.—**Gnat Trainer.**

G. F. Thornton, D.F.C.—Sales department, de Havilland Aircraft Co., Ltd. Born, 1922. Joined de Havilland from R.A.F., 1949.—**Dove 8.**

E. B. Trubshaw.—Chief test pilot, Vickers-Armstrongs (Aircraft), Ltd. Born, 1924. Joined R.A.F., 1942. Joined Vickers-Armstrongs, 1950; deputy chief test pilot in 1952.—**Vanguard.**

P. Varley.—Test pilot, Sir W. G. Armstrong Whitworth Aircraft, Ltd. Born, 1924. Joined R.A.F., 1941. E.T.P.S. course, 1950. Later Boscombe Down. Joined Gloster, 1955. Joined A.W.A., 1958.—**Argosy.**

D. J. Whitehead, A.F.C.—Chief test pilot, Blackburn Aircraft, Ltd. Born, 1925. Qualified as pilot in R.A.F., 1945, and transferred to R.N. E.T.P.S. course, 1954; Naval Test Squadron, Boscombe Down. Joined Blackburn, 1958.—**NA.39.**

P. R. D. Wilson.—Test pilot, Westland Aircraft, Ltd. Served with the Regular Army, 1939-1952. Helicopter test pilot, A.F.E.E. Beaulieu, 1949-52. Joined Bristol, 1952.—**Belvedere.**

G. Worral.—Chief production test pilot, Gloster Aircraft Co., Ltd. Born, 1922. Joined R.A.F., 1940. Left R.A.F., 1946, and joined Gloster; became test pilot in 1950.—**Javelin FAW.9.**

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Aircraft can always get off to a good start with the aid of a Murex Ground Power Unit. These diesel engine-driven equipments are designed to supply instant and reliable power for the starting and servicing of a wide range of piston, turbo jet and turbo prop aircraft and they are used by leading operators and manufacturers throughout the world. Special models can be supplied to meet individual requirements, but standard equipments are designed to provide a peak load of 2,000 amperes for engine starting and a current of 600 amperes continuously at 28 volts for servicing and preflight checks. Please write for full details.

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Correspondence

Worth Shouting About

WE have never been so proud to be British than recently when my family and I spent our holiday in the Netherlands. The reason for this was the excellent services provided by the newly formed British United Airways, and their associated company, Air Charter, Ltd. (Channel Air Bridge). It goes without saying that car and passenger air services render a unique British way of travel, especially so on the longer air routes, such as Southend to Rotterdam, which we took.

I have travelled in the past by car and various other ways to the Netherlands, but this holiday, unfortunately behind us, gave us everything a traveller requires.

We started from Maidenhead and arrived in Amsterdam in just under five hours, which was due to the efficient way car and passengers were handled at Southend and Rotterdam. During this time we were able to relax for 69 minutes, during the flight.

The overall travel cost for three passengers and a 12-ft.-long car was only a few pounds more than if we had gone from London Airport, but then we would not have been able to take the car with us—and cars are quite expensive to hire on the Continent.

We were, however, sorry to learn that practically none of our Dutch friends knew anything about this excellent service. We feel, therefore, that British United Airways could do with more advertising in the Netherlands and would, no doubt, reap the benefit.

After buying duty-free cigarettes and various bottles of spirits, in the passenger section of the aircraft, we found it amusing to ask the steward to put our purchases in our car, half an hour out of Southend.

Britain can be proud of their independent airlines and they deserve to go from strength to strength.

H. J. HOLLEMAN.

Maidenhead.

Photographs Wanted

TUCKED away in a corner of the July-August number of *Aero France* (the official organ of the Aéro Club de France) is a paragraph with the title: "ENVOYEZ AU MUSEE DE L'AIR DES PHOTOS DE MONUMENTS." It is an appeal to anybody who has an aeronautical monument in his neighbourhood to send a photograph of it (if possible with the negative) to the museum where a collection is being made of such illustrations.

This is, of course, a typical "task" of the Musée de l'Air which exists to preserve every conceivable aspect of French aviation. French is, however, the operative word since the Musée concentrates on the national scene almost to the exclusion of any other aeronautical interests.

Piccadilly. F.H.S.

G.A.P.A.N.'s Court History

THE photograph of the Guild of Air Pilots and Air Navigators' Court in session presided over by the Grand Master, H.R.H. The Prince Philip, Duke of Edinburgh, K.G., may arouse queries in the minds of some of your readers not acquainted with the Guild's history because of the legend's references to Grand Master, Master and Past Deputy Master without any mention of a present Deputy Master or a Past Master (THE AEROPLANE AND ASTRONAUTICS, Jly. 22 last).

The lack of reference to a Past Master arises from the absence in the group of any Past Master present as such. But Wg. Cdr. C. A. Pike and J. Lankester Parker are Past Masters, but were present by virtue of their current offices as stated in your legend.

When the Guild was founded in 1929 it was decided to have three senior officers, a Grand Master, a Master, and an annually elected Deputy Master. The office of Grand Master was not then filled because the fledgling Guild had first to grow its wings. Thus, at that time, it was agreed that it must have a Master from outside its own ranks to give it added status. But to provide for the authority of its own membership the office of Deputy Master was filled from the outset by a professional member of the Guild.

The first Master was Air Vice-Marshal Sir Sefton Brancker, then Director of Civil Aviation, who had played a great part in establishing the Guild. Following his tragic death in the R.101 on October 5, 1930 (and that of the first Deputy Master, Sqn. Ldr. E. L. Johnston), Capt. the Rt. Hon. F. E. Guest, a former Secretary of State for Air, became Master and after his death in 1937 the Marquess of Londonderry, K.G., also a former Secretary of State for Air, filled the office until his death in February, 1949. The Guild was indeed fortunate to have the valuable counsel and inspiring leadership of these three great figures in British aviation.

H.R.H. Edward, Prince of Wales, K.G., had graciously consented to become the Guild's first Grand Master at a suitable time, but with his accession to the Throne as King Edward VIII this became impossible of realization.

H.R.H. The Duke of Kent, K.G., became the Guild's first Grand Master in October, 1936. He died in an air crash in 1942. H.R.H. The Princess Elizabeth graciously accepted the Grand Mastership in January, 1947. After Lord Londonderry's death, in accordance with a wish expressed by the Grand Master, the Court decided that in the future the Master should be appointed annually from the working members of the Guild, as in the City Companies. The office of Deputy Master was abolished and on Apr. 7, 1949, the Guild's Court invited Gp. Capt. W. N. Cumming, the last installed Deputy Master, to be the first working Master. Since that date the list of Deputy Masters and Masters has been regarded as the continuous line of the most senior officers of the Guild.

On the accession of Her Majesty Queen Elizabeth II, H.R.H. The Duke of Edinburgh graciously consented to be the Guild's third Grand Master.

Cadgwith, Cornwall. NORMAN MACMILLAN
(Past Deputy Master 1934-35, G.A.P.A.N.).

Groundabout

Time Flies. At the S.B.A.C. Display, an R.A.F. Coastal Command Shackleton is to take off at the end of each day's flying, patrol out over the Atlantic and return 22 hours later to land at the beginning of the next day's display. This supports the R.A.F.'s claim that they not only give the aircrew chap a good pension at retiring age they also see to it that he gets older quicker.

*

Going, Going, Gong. A company's pre-Farnborough hand-out on the career of one of their test pilots ended with this slightly deflating sentence: "He was one of the 19,000 aircrew to be awarded the D.F.C."

*

The Name Game. I've just come across the conditions which governed B.E.A.'s competition to choose a name for their D.H. 121—"The name should give confidence in the aircraft, rebound to B.E.A.'s credit, capture the popular imagination and help sell the aircraft in the world's markets." Well, of course, on those terms there was only one name it *could* be—*TRIDENT*. Incidentally, I'm looking forward to a future Paris Show commentator exhorting us to regard the formidable Treedong.

*

The Song of the Aerial Applicator: "Coming in on a Wing and a Sprayer."

*

Convenience. Parliamentary answer which a Minister will one day give when pressed beyond endurance: "It would not be in the public interest to say why this information would not be in the public interest. . . ."

*

Honourable Payload. After Allegheny have made a success of their "Pay-as-you-board" Eland-Convairs, the Japanese are going one better with their Viscounts which will soon be delivered to *ALL NIP-ON AIRWAYS*.

*

"Boy! Dig that crazy beat . . .!"

by Gregg

Industry Record

Aerial Survey Development

A new type of aerial camera that can photograph an area of 593 sq. miles from a height of 50,000 ft. in a single exposure on a negative 9 in. square is to be used by Fairey Air Surveys, Ltd., for the aerial photography of 26,000 sq. miles of British Guiana. A Wild RC-9 super-wide-angle camera, it is of Swiss design and manufacture; its lens has a focal length of 3.5 in.

In British Guiana the flying height will be 15,000 ft. and at that altitude a single exposure will cover 53 sq. miles compared with the 18 sq. miles covered by a standard camera at the same height. The RC-9's large coverage will also be particularly useful in British Guiana, where weather conditions are appalling and opportunities for aerial photography none too frequent.

Because of the prevailing mist, rain and low cloud, five radio reporting stations are being set up in the interior of the country. They will report several times a day direct to the aircraft in flight so that immediate advantage may be taken of any local patches of good weather that the radio operator may have found.

This is the third consecutive year that Fairey Air Surveys has received a major contract for aerial photography in British Guiana. The aircraft assigned to work is a specially equipped DC-3, fitted with long-range fuel tanks.

Aerlinte Eireann Boeing 720s expected in service late this year are to be equipped with the Beaufort 26V reversible liferaft. A 26 seater, it meets both A.R.B. and F.A.A. requirements.

Swissair is now using Auto Diesels turbine starters for its DC-8s at Zürich and Geneva airports. They are mounted on Ford vans; in the front of the van is the hose connection to the aircraft.

Change of Name

The name of the company marketing Ampex magnetic tape recording equipment in the United Kingdom has been changed from Redwood City Engineering, Ltd., to Ampex Great Britain, Ltd. The company will continue to perform the sales, service and liaison function previously undertaken by Redwood City Engineering, Ltd. A subsidiary of Ampex International S.A., Fribourg, Switzerland, its offices are at Arkwright Road, Reading, Berks.

Publications Received

Village of Stars. Carrying an untried nuclear weapon, an R.A.F. bomber is sent on patrol during an international crisis; when war is averted, the bomb cannot be defused. The plight of the bomber and its crew forms the climax to this exciting novel with its authentic background of life on a V-bomber station. By Paul Stanton. 208 pp.; 5½ in. by 8 in. Michael Joseph, Ltd. Price 12s. 6d.

The Driving Test Fully Explained. Sixth edition of an established guide published in association with *The Motor*. By F. S. Hollidge. 136 pp., 4¾ in. x 7¼ in. Illustrated. Temple Press Limited. 6s. 6d.

Aviation Calendar

Sept. 9

Cranfield.—International Rally organized by the Popular Flying Association; until Sept. 12.

Sept. 10

Cardiff (Rhoose) Airport.—At Home organized by the Glamorgan Flying Club; until Sept. 11.

Sept. 12

Zurich.—International Congress of Aeronautical Sciences; until Sept. 16.

Sept. 14

London.—Ultra Anniversary lecture. "The Evolution of Instrumentation," by Prof. A. Porter, in the Recital Room, Royal Festival Hall.

Sept. 16

Oxford.—Institute of Transport Week-end Course at New College; until Sept. 19.

Sept. 17

Battle of Britain "At Home" day. Twenty-five R.A.F. stations are open to the public.

Sheffield.—Norton Air Show.

Sept. 18

Boston, Lincs.—Battle of Britain Sunday.

Sept. 25

Dunstable Downs.—National Aerobatic Contest organized by the London Gliding Club, at 11.00 hrs.

Sept. 27

London.—The Institution of Mechanical Engineers Symposium on Automatic Control; until Sept. 28.

Sept. 28

London.—Society of Environmental Engineers lecture, "The Development and Testing of Small Electronic Components," at Imperial College, S.W.7, at 18.00 hrs.

London.—Northampton College of Advanced Technology start of 1960-61 session of post-graduate lectures in Aeronautical Engineering, at the College, St. John Street, E.C.1. Full details can be obtained from the College.

Oct. 3

Istanbul.—AGARD 16th meeting of the Aero Space Panel; until Oct. 8.

Istanbul.—AGARD 4th Avionics Panel Symposium on "Radio Navigation"; until Oct. 9.

Oct. 6

Istanbul.—Tenth AGARD General Assembly; until Oct. 7.

New Companies

NORFOLK GLIDING CLUB, LTD. (662,834).—Reg. Aug. 4 as a company limited by guarantee without share capital. Original number of members is 20 each liable for £5 in event of winding up. The management is vested in a council the first members of which are: Dr. R. Tringham, 182 Thunder Lane, Thorpe, Norwich; John T. Wilkins, 93 Taverham Road, Taverham, nr. Norwich; David G. Taylor, P. A. Crabtree and E. A. Cunningham. Sols.: Hill and Perks, Norwich. Reg. off.: 36 Prince of Wales Road, Norwich.

PREMIER AIR LINES, LTD. (667,038).—Private co. Reg. Aug. 8. Cap. £5,000 in £1 shs. Agreement with Continental Air Transport, Ltd., and Premier Travel, Ltd., for the acquisition of the business of operators of and agents for air services carried on by them at Cambridge, etc. Directors: Edward A. Lainson, 24 Panton Street, Cambridge; Ian J. Maclean, 1 Coach House Buildings, St. Saviour, Jersey, C.I.; Frank N. Matthews, 24 Milton Road, Cambridge; Mrs. Martha M. Maclean, 64 Whitehouse Road, Eastwood, Essex. Sec.: R. C. H. Dodkin. Sols.: Partridge and Wilson, Bury St. Edmunds. Reg. off.: 15 Market Hill, Cambridge.

AIRCRAFT DISTRIBUTORS, LTD. (667,319).—Private co. Reg. Aug. 11. Cap. £1,000 in £1 shs. Importers and exporters of and agents for and dealers in aircraft, engines and accessories. Sols.: McKenna and Co., 10 Whitehall, S.W.1.

STANLEY NEILL AND PARTNERS, LTD. (667,393).—Private co. Reg. Aug. 11. Cap. £100 in £1 shs. Consultants, advisers, patentees manufacturers of and dealers in machines or apparatus designed for aerial transit, guided missiles, aeroplanes, etc. Directors: Stanley F. M. Neill and Jean C. Neill, both of Hyde House, Darkes Lane, Potters Bar, Middlesex. Sec.: Jean C. Neill. Sols.: Blacket Gill and Prior, W.C.1. Reg. off.: 9 Staple Inn, Holborn, W.C.1.

POPULAR AVIATION REVIEW CO., LTD. (667,502).—Private co. Reg. Aug. 11. Cap. £3,000 in £1 shs. Publishers. Directors: Michael J. Conry and Margaret N. Conry both of High Bank, Ide Hill, Oxted, Surrey. Sec.: Margaret N. Conry. Reg. off.: 1 Leadenhall Street, E.C.3.

AGRIAIR, LTD. (667,682). Private co. Reg. Aug 15. Cap. £400 in £1 shs. Agricultural and aerial photographers. Directors: Gerhardus Greeff and Craig R. Woods, both of 31 Philbeach Gardens, S.W.5. Jon N. Panos, 30 Philbeach Gardens, S.W.5. Sec.: C. R. Woods. Reg. off.: Luton Flying Club, Luton Airport, Bedford.

ROTAX-GARRETT, LTD. (668,161).—Private co. Reg. Aug. 19. Cap. £100,000 in £1 shs. Designers and manufacturers of and dealers in electrical, electronic, electro-mechanical, mechanical, hydraulic and pneumatic equipment for aircraft and missiles. Directors: M. Luby, E. R. Legg, R. H. Woodall, B. S. Clark, E. A. Bellande and T. W. von der Nuell. Sols.: Eversheds and Tomkinson, Birmingham, 8.

Personal Notices

BIRTHS

Badeni.—On Aug. 22, at Westbourne Avenue Maternity Home, Hull, to June (*née* Wilson), wife of Sqn. Ldr. Jan Badeni—a daughter.

Curry.—On Aug. 24, at Dundee Royal Infirmary, to Janice (*née* Parr), wife of Flt. Lt. A. C. Curry—a son.

Elsegood.—On Aug. 18, at Moreton-in-Marsh Hospital, to Bridget, wife of Flt. Lt. W. W. Elsegood—a daughter.

Petts.—On Aug. 27, at R.A.F. Hospital, Akrotiri, Cyprus, to Margaret (*née* Brasher), wife of Flg. Off. N. R. Petts—a daughter.

Petts.—On Aug. 24, at R.A.F. Hospital, Akrotiri, Cyprus, to Ruth, wife of Flt. Lt. J. E. Petts—a daughter.

Russell.—On Aug. 27, at R.A.F. Hospital, Nocton Hall, Lincoln, to Diana (*née* James), wife of Sqn. Ldr. L. J. Russell—a daughter.

DEATHS

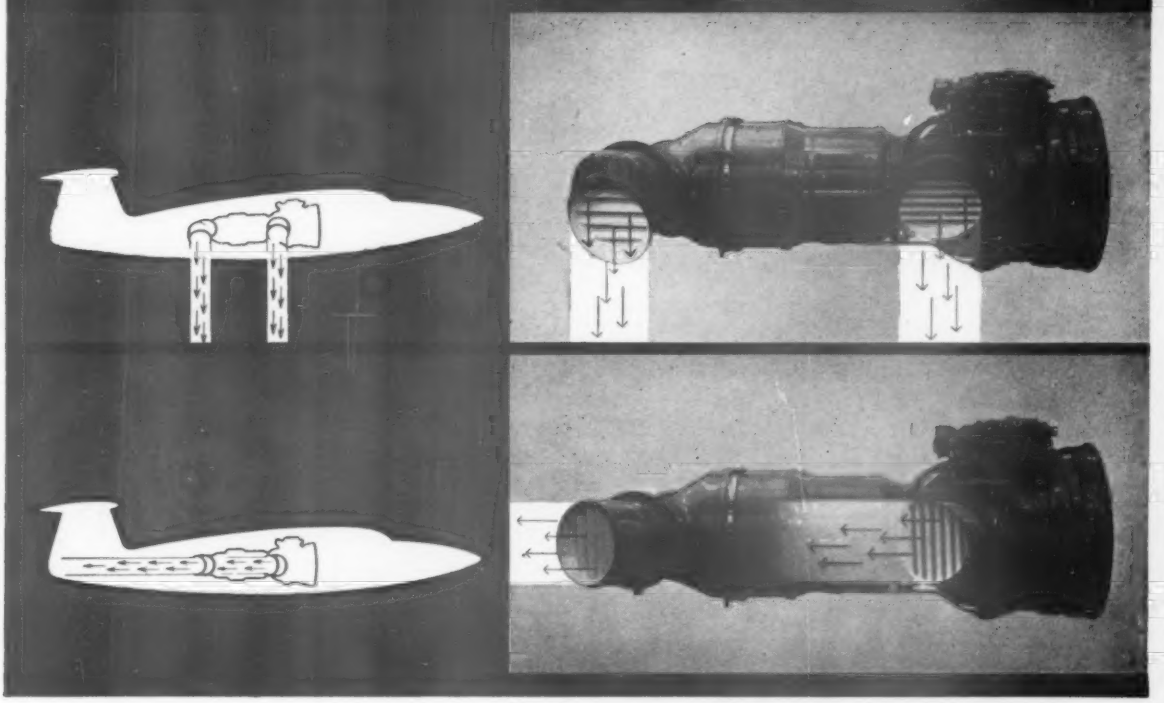
Bailey.—On Aug. 29, at Cape Town, the Hon. Lady Mary Bailey, D.B.E.

Brushwood.—On Aug. 20, Wg. Cdr. Horace Edgar Brushwood, O.B.E., R.A.F. (Retd.).

Finch.—On Aug. 19, Gp. Capt. E. S. Finch.

Rook.—On Aug. 26, A.V.M. Sir Alan Filmer Rook, K.B.E., C.B., M.R.C.S., F.R.C.P., D.P.H.

LIFT and THRUST from ONE ENGINE— the Revolutionary BS 53 Turbofan



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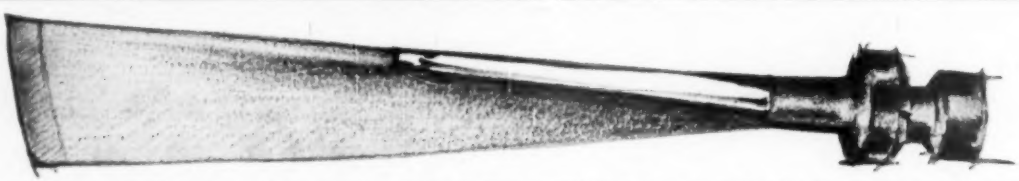
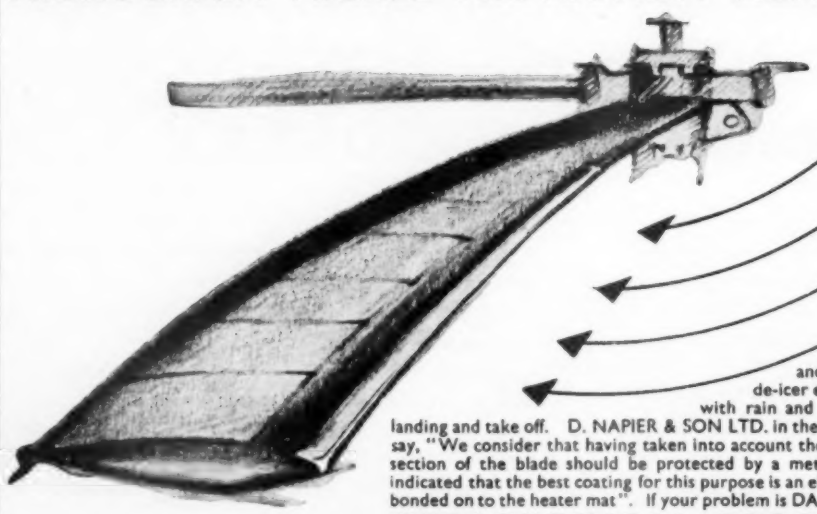


MICROGRAIN NICKEL PROTECTION AGAINST **DAMAGE**



Electroforms of Micrograin nickel on the leading edges of aircraft propellers and helicopter rotors protect the delicate de-icer elements against rupture due to impact with rain and hail in flight or with stones during landing and take off. D. NAPIER & SON LTD. in their Spraymat information bulletin IB/SII say, "We consider that having taken into account the aircraft forward speed the outboard section of the blade should be protected by a metallic coating. Extensive testing has indicated that the best coating for this purpose is an electroformed Micrograin nickel sheath bonded on to the heater mat". If your problem is DAMAGE, the solution is MICROGRAIN.

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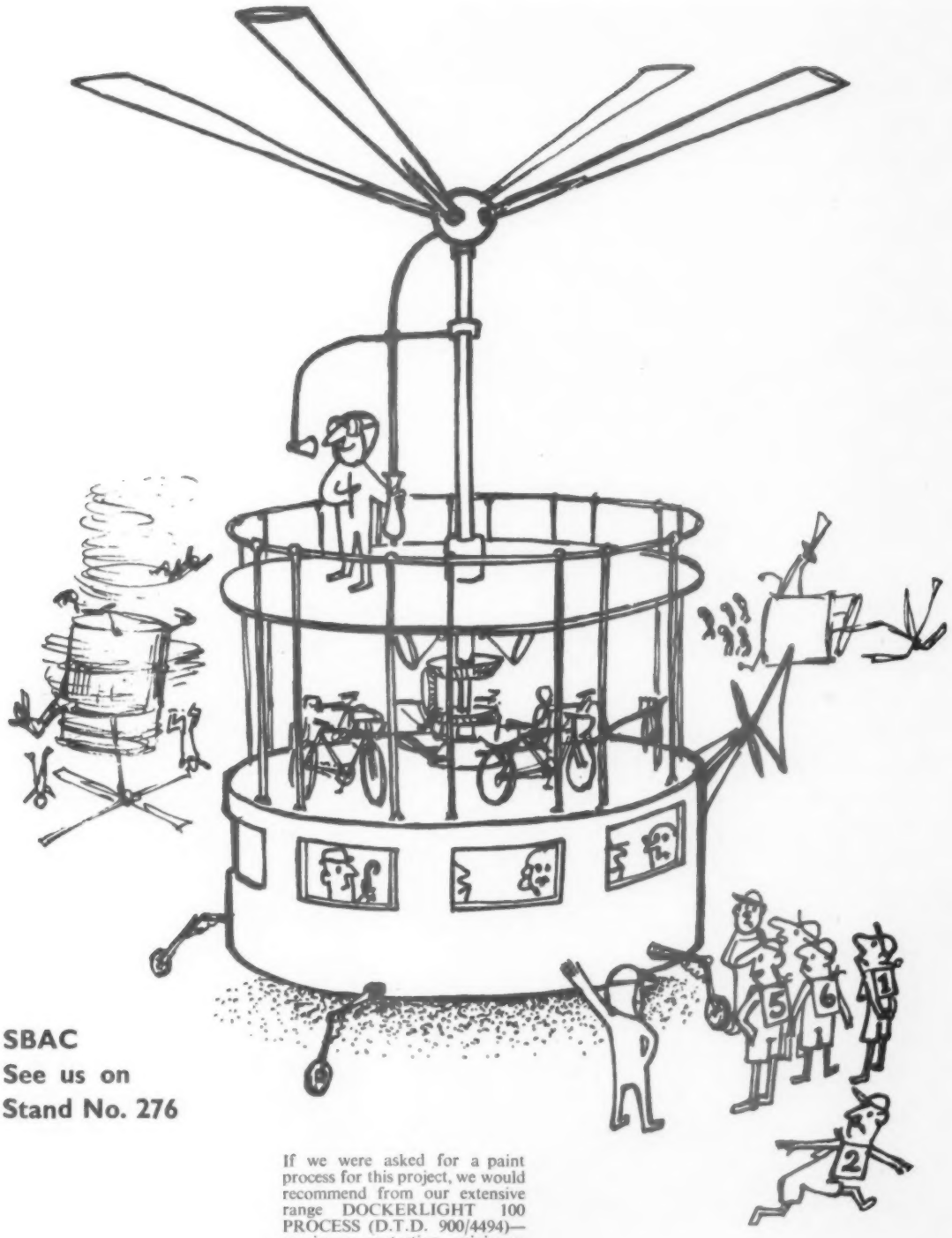

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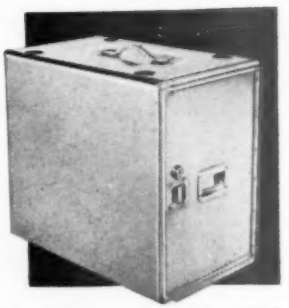

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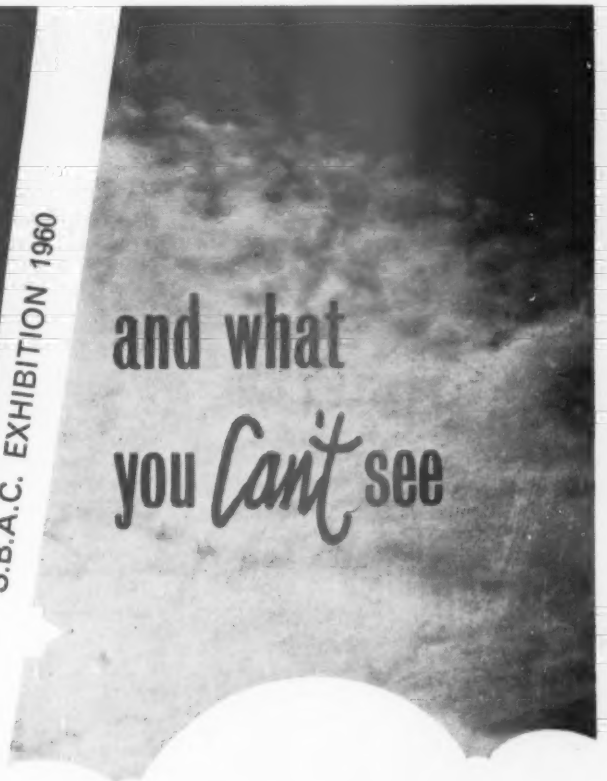
and what you *can't* see



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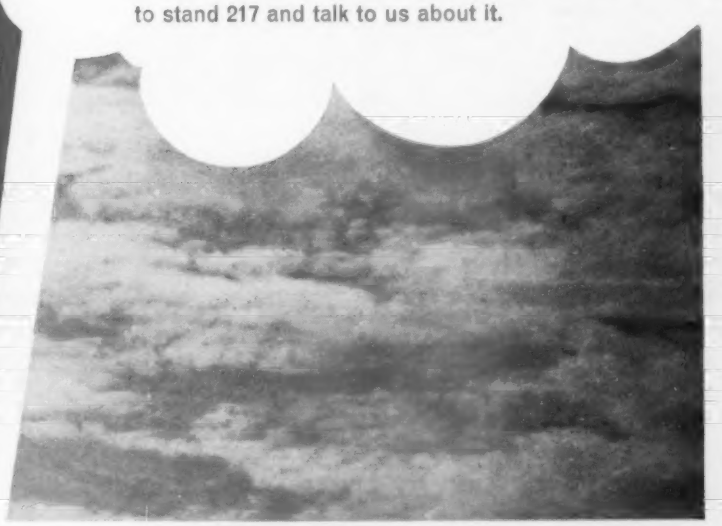

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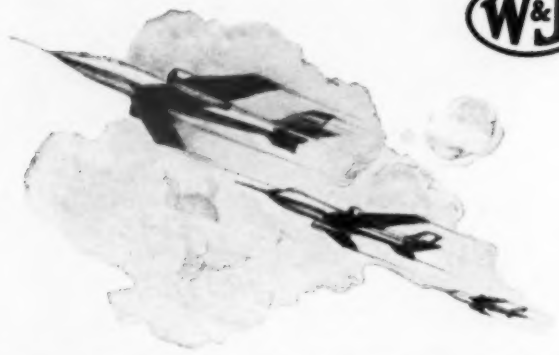

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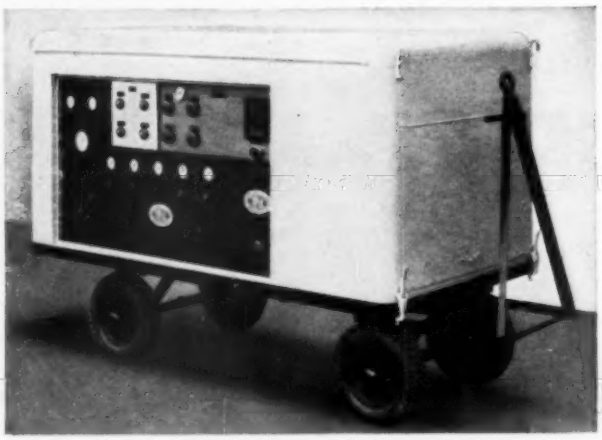

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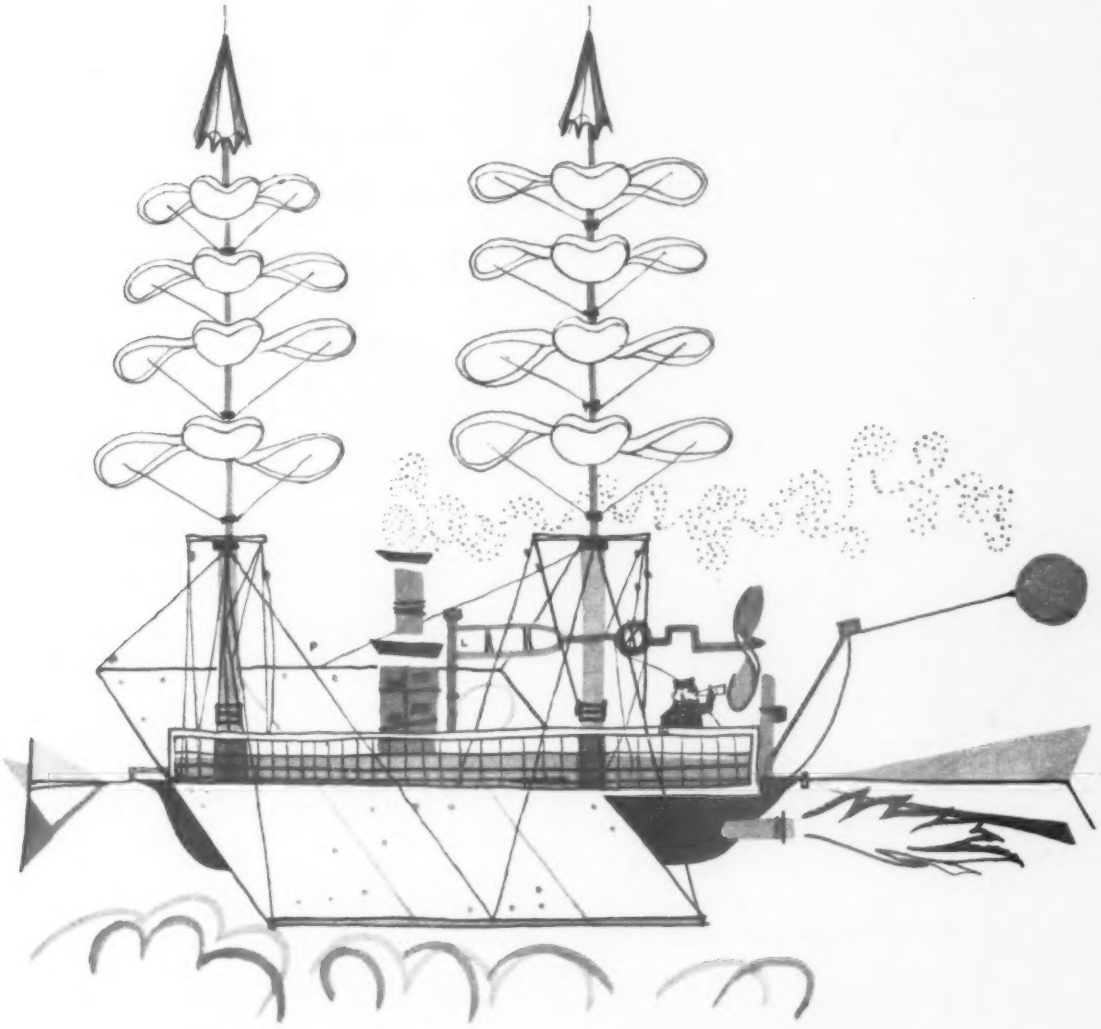

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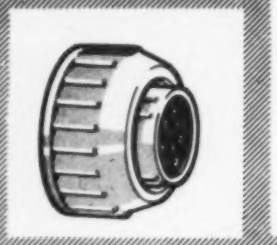

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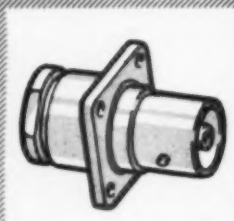
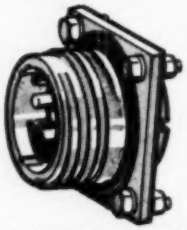
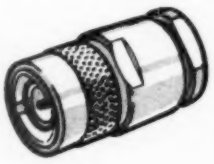
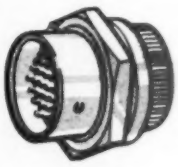

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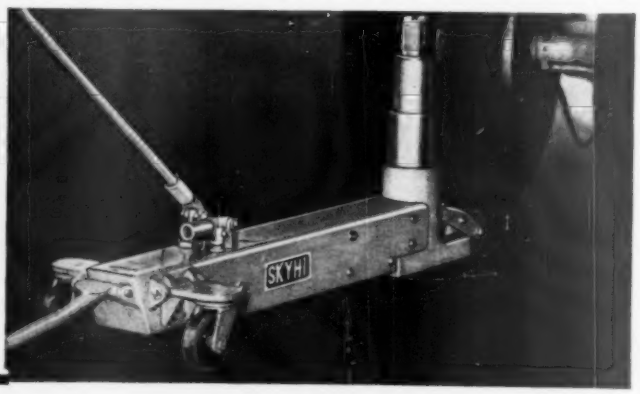

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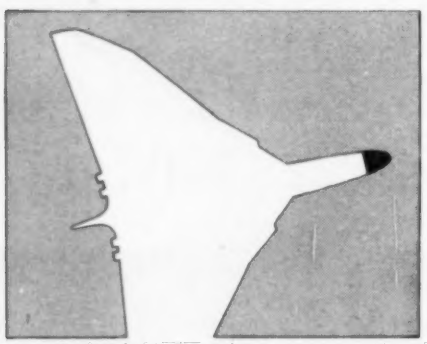

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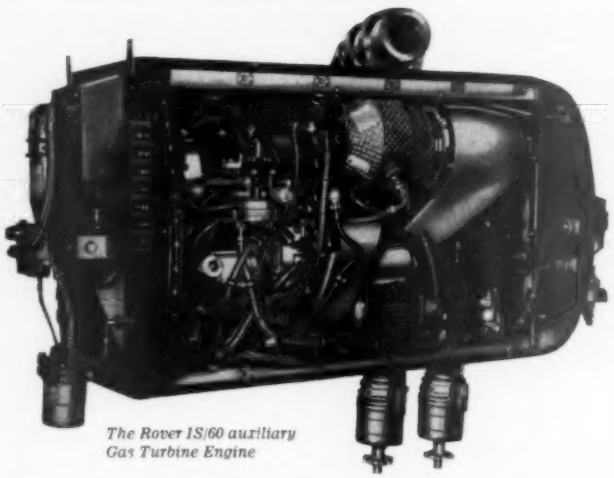

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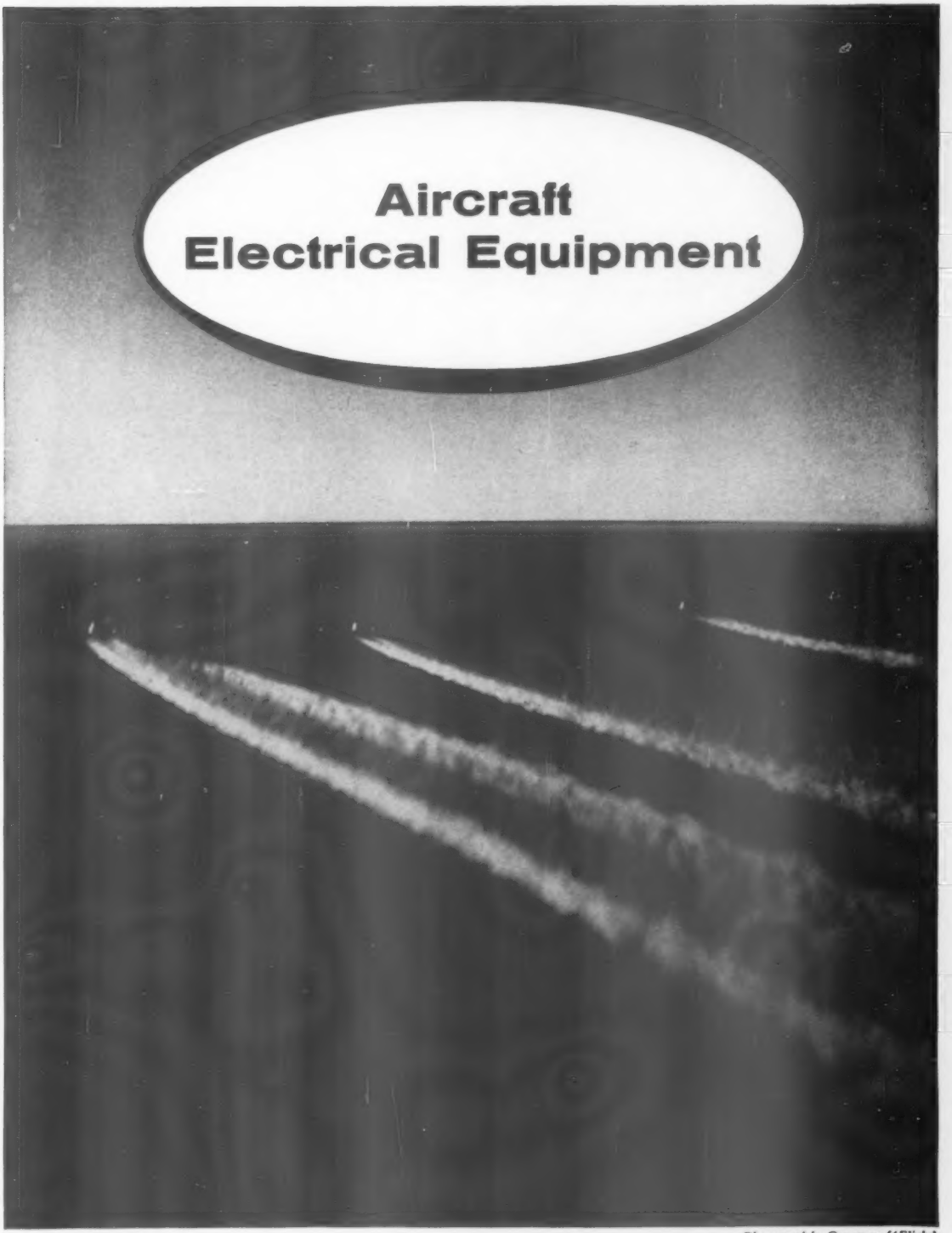

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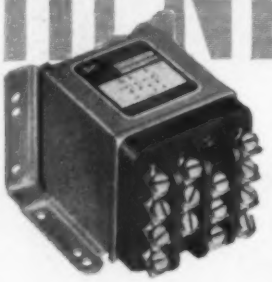

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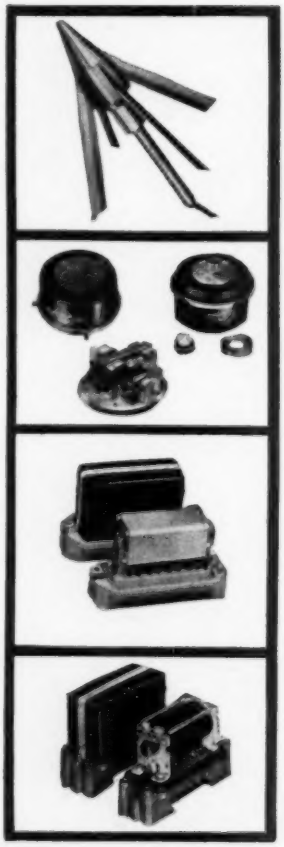

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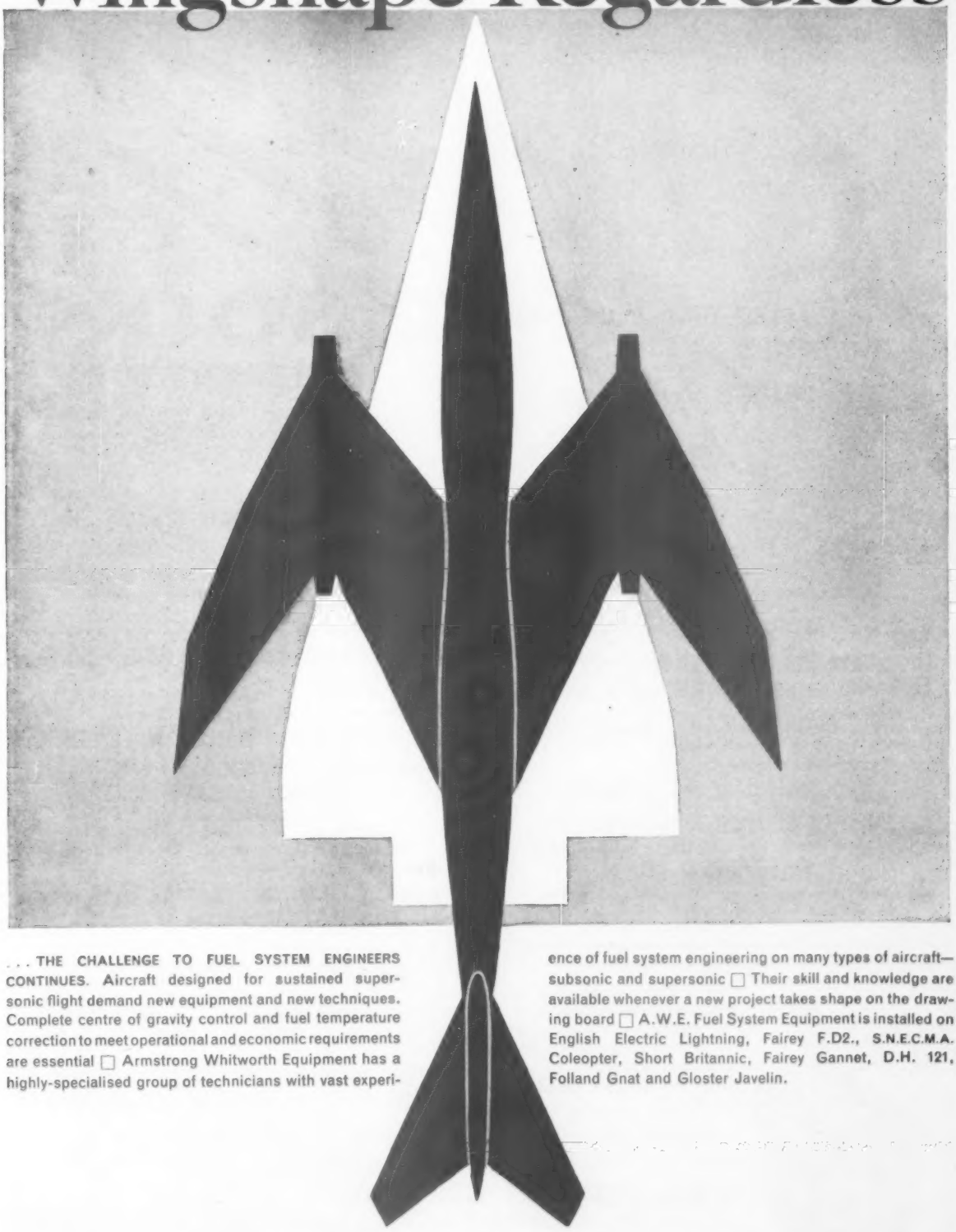

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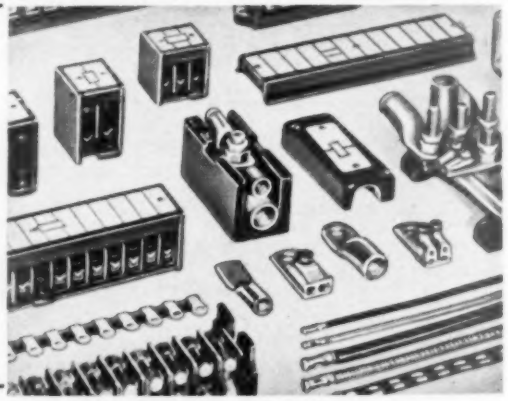

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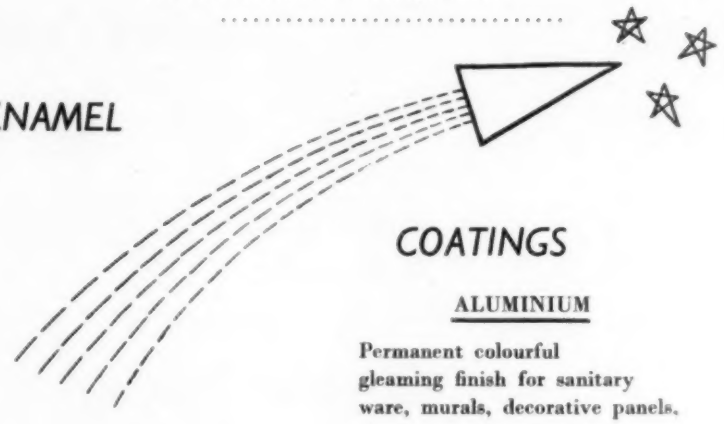

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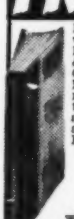

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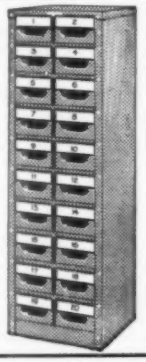

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AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:—

FROM B.K.S. AIR TRANSPORT, LTD., OF BERK HOUSE, BAKER STREET, LONDON, W.1:—

APPLICATION NO. 3371/1 (amended) for an amendment to the terms of approval of the All Freight Service which they are authorized to operate with Dakota, B.170 and Ambassador aircraft on the route Luton-Leeds/Bradford (opt.)-Belfast, at a frequency of three return flights weekly until March, 1967, so as to enable them to operate at an increased frequency of seven return flights weekly on the amended route Southend (opt.)-Luton-Leeds/Bradford (opt.)-Belfast.

APPLICATION NO.2184-1 (amended) for an amendment to the terms of approval of the All Freight Service which they are authorized to operate with Dakota aircraft between Leeds/Bradford and Belfast, at a frequency of two return flights weekly until November, 1965, so as to enable them to operate at an increased frequency of seven return flights weekly on the amended route Leeds/Bradford and/or Liverpool-Belfast.

APPLICATION NO. 1466/4 for an amendment to the terms of approval of the Normal Scheduled Service which they are authorized to operate with Dakota and Ambassador aircraft on the route Newcastle-Edinburgh (opt.)-Bergen and/or Stavanger at a frequency of four return flights weekly until March 31, 1965, so as to enable them to operate on the amended route Leeds/Bradford and/or Newcastle-Edinburgh (opt.)-Bergen and/or Stavanger.

These applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30, 1952. Any representations or objections with regard to these applications must be made in writing stating the reason and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the application may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections.
551-6

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UNIVERSITY OF BELFAST.

THE Senate of The Queen's University of Belfast invites applications for a special assistant lectureship in aeronautical engineering from January 1, 1961, or such other date as may be arranged. Qualifications should preferably include a degree in aeronautical engineering at a level which would qualify the applicant to undertake a Ph.D. Salary on the scale £800 x £50 to £950, plus F.S.S.U. Placing on the scale will depend on age, qualifications and experience. Applications should be received by September 30, 1960. Further particulars may be obtained from G. R. Cowie, M.A., LL.B., J.P., Secretary. 551-5

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Vol. 99. No. 2551

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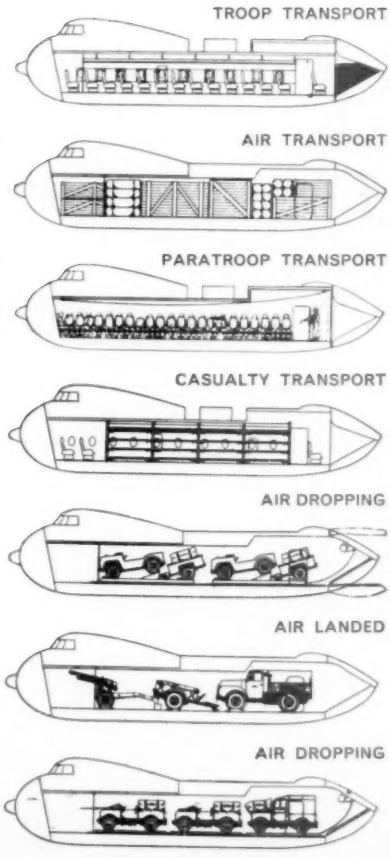

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